S-TECH
1700B

MODEL 1700B* OPTION 003

AUTOMATIC SET-LEVEL

SOUND TECHNOLOGY

MASTER
1700B
OPTION B

PRICE: $ 5.00

USER'S MANUAL

MODEL 1700B* OPTION 003

AUTOMATIC SET-LEVEL

SOUND TECHNOLOGY

SOUND TECHNOLOGY
1400 Dell Avenue
Campbell, CA 95008
U.S.A.
(408) 378-6540
*Patents Pending

June, 1975

CONTENTS

OPERATING PROCEDURE

a. Complete normal signal connections to the amplifier under test as described on page 1-3 of 1700A Manual.

b. Rotate the ADJUST Control fully counter-clock wise, past the CAL position, until a click is heard. This activates the auto-set-level circuitry.

c. Select VOLTS/POWER function and adjust INPUT range switch so that the voltage (or power) reading is obtained with the meter pointer in the upper two-thirds of meter scale. (Levels lower than 1/3 and much greater than full-scale will cause errors in distortion readings.)

d. Select DISTORTION function and take the distortion reading in the usual manner.

NOTE

1. The overload light will glow whenever the VOLTS/POWER meter is being overloaded by more than 10% during distortion measurements. It is meant to inform the operator to up-range (advance the INPUT switch) while monitoring the distortion figure.

NOTE

2. It is normal for the residual noise to increase slightly with the Auto-Set-Level circuit in operation. The error in distortion reading due to this noise is, in general, insignificant when the distortion figure is .02% or greater.

OPERATING PROCEDURE

a. Complete normal signal connections to the amplifier under test as described on page [illegible] of 1710A Manual.

b. Rotate the ADJUST Control fully counter-clock wise, past the CAL position, until a click is heard. This activates the auto-set-level circuitry.

c. Select VOLTS/POWER function and adjust INPUT range switch so that the voltage (or power) reading is obtained with the meter pointer in the upper two-thirds of meter scale. (Levels lower than 1/3 and much greater than full-scale will cause errors in distortion readings.)

d. Select DISTORTION function and take the distortion reading in the usual manner.

NOTE

1. The overload light will glow whenever the VOLTS/POWER meter is being overloaded by more than 10% during distortion measurements. It is meant to inform the operator to up-range (advance the INPUT switch) while monitoring the distortion figure.

NOTE

2. It is normal for the residual noise to increase slightly with the Auto-Set-Level circuit in operation. The error in distortion readings due to this noise is, in general, insignificant when the distortion figure is .02% or greater.

PRINCIPLES OF OPERATION

The signal input to the Notch Filter (or the variable output of Buffer) is fed to the AC to DC Converter (U1, U2). The DC signal out of this converter, which is directly proportional to the Notch Filter input signal level, is in turn driving a Voltage to Current Converter (U3), which regulates the controlling current to the Multiplier. The Multiplier is used as a variable gain amplifier (gain range from 1 to 3.16). Its gain is inversely proportional to the controlling current and the magnitude of the AC signal to the Notch Filter.

In the manual distortion-measurement mode, whenever the input signal is below full-scale (but more than 1/3 on VOLTS scale), Buffer Amplifier gain has to be increased with the use of the ADJUST control to make up for the lower amplitude. In the automatic mode, the distortion signal level is increased to exactly the required amount through the Multiplier before it goes to the AC meter. The net effect is the same as increasing the Buffer Amplifier gain, and the distortion readings obtained in this manner will always be accurate.

Since the Multiplier is precessing signals after the Notch Filter, it is not adding distortion to the signal being analyzed. As a matter of fact, this scheme actually reduces the residual distortion noticably above 50 kHz when the input signal is significantly below full-scale. However, there is some degradation of signal-to-noise ratio whenever the Notch Filter is operating with a smaller signal.

OPERATING PROCEDURE

a. Complete normal signal connections to the amplifier under test as described on page 1-3 of 1700A Manual.

b. Rotate the ADJUST Control fully counter-clock wise, past the CAL position, until a click is heard. This activates the auto-set-level circuitry.

c. Select VOLTS/POWER function and adjust INPUT range switch so that the voltage (or power) reading is obtained with the meter pointer in the upper two-thirds of meter scale. (Levels lower than 1/3 and much greater than full-scale will cause errors in distortion readings.)

d. Select DISTORTION function and take the distortion reading in the usual manner.

NOTE

1. The overload light will glow whenever the VOLTS/POWER meter is being overloaded by more than 10% during distortion measurements. It is meant to inform the operator to up-range (advance the INPUT switch) while monitoring the distortion figure.

NOTE

2. It is normal for the residual noise to increase slightly with the Auto-Set-Level circuit in operation. The error in distortion reading due to this noise is, in general, insignificant when the distortion figure is .02% or greater.

PERFORMANCE CHECK FOR

AUTO-SET-LEVEL OPTION

a. Connect cable between SIGNAL OUTPUT BNC connecter and INPUT terminals.

b. Set Model 1700A controls as follows:

SIGNAL COMMON switch	⏚
INPUT switch	1V
ADJUST control	CAL
FUNCTION	VOLTS/POWER
FAST RESPONSE/LOW DISTORTION Switch	FAST RESPONSE
FREQUENCY pushbuttons	X100, 10 (1 kHz)
FILTERS pushbuttons	80 kHz

c. Adjust OSCILLATOR LEVEL control for .95V rms as indicated on meter.

d. Depress SET LEVEL pushbutton and rotate ADJUST control until meter pointer is exactly over SET LEVEL mark.

e. Depress DISTORTION pushbutton and set RATIO switch to proper range (.03% or .1%) to obtain a good reading (meter pointer in upper 2/3's of meter scale). Note this distortion reading.

f. Now, rotate the ADJUST control counter-clockwise until a "click" is heard. (• AUTO position).

g. Note distortion reading on meter. This reading should be the same as the one noted in step e with an error no greater than 2 minor divisions on the 0-1 scale.

h. Change INPUT switch to 3V range (set level is now reduced by 10 dB) and note distortion reading on meter. This reading should be the same as the one noted in step e with an error no greater than 2 minor division on the 0-1 scale.

i. Set FREQUENCY pushbuttons to X1000, 100 (100 kHz) and OSCILLATOR LEVEL control fully CW (Maximum output).

j. With 80 kHz FILTER turned off, manually SET LEVEL to obtain distortion reading. Note this reading on dB meter scale.

k. Rotate the ADJUST control counter-clockwise until a "click" is heard. Note the distortion reading on dB meter scale. This reading should agree with the one obtained in step j within 1 dB.

NOTE

It is normal for the distortion reading to drop when the input signal is reduced 10 dB below set level mark at 100 kHz. This is because the residual distortion of the analyzer has been greatly reduced with the decrease in input level at 100 kHz.
(A bonus benefit from the Auto-Set-Level Option).

l. Depress VOLTS/POWER function switch, change INPUT switch to 1V, and change Oscillator frequency to X100, 10 (1kHz). Decrease OSCILLATOR LEVEL control rapidly until OVERLOAD indicator is extinguished. Then increase OSCILLATOR LEVEL very slowly until OVERLOAD indicator just begins to glow (adjust control back and forth if necessary to find the point at which indicator just starts to light).

m. Now change INPUT switch to the 3V position and note meter reading. Meter pointer should be between -9.5 and -8.5 on dB scale (106 and 118 on 0-3V scale).

CALIBRATION PROCEDURE FOR
1700A AUTOMATIC SET-LEVEL OPTION

a. Center all four trim-pots on Auto-Set-Level PC board and turn power on.

b. Connect oscillator SIGNAL OUTPUT to analyzer INPUT.

c. Set 1700A controls to:

INPUT switch	300V
FUNCTION	SET-LEVEL
ADJUST control	CAL (Max. CCW-Just before click)
RATIO switch	0 dB (100%)
FILTERS	Both Off (out)
FREQUENCY	X 100, 10 (1 kHz)
F.R./L.D.	FAST RESPONSE
SIGNAL COMMON Switch	

d. Set OSCILLATOR LEVEL at minimum (fully CCW). Measure DC voltage at (+) terminal of C7 (10 Microfarad) with respect to ground (-terminal of C15). Adjust zero trim-pot R21 for 0 Volt (±1 mV) DC.

e. Change INPUT switch to 1V and adjust OSCILLATOR LEVEL for exactly full scale (set level mark.)

f. Change FUNCTION to dB VOLTS and note the exact position of meter pointer on 0 to 1 scale.

g. Click the ADJUST control to • AUTO position.

h. Measure DC voltage at N.C. contact of relay K1 (as shown on parts location diagram) with respect to ground (negative terminal of C15). Adjust zero trim-pot R20 for zero volts DC ± 5 mV.

i. With INPUT switch in 1V position, adjust F.S. trim-pot R7 for the same pointer position as in step f.

j. Change INPUT switch to 3V and adjust offset trim-pot R14 for the same pointer position as in step i.

k. Repeat steps i and j until meter pointer rests on the same spot, ±.1% of full-scale (± one line width).

TROUBLE-SHOOTING

The Auto-Set-Level circuit is an open-loop type, so straightforward signal tracing techniques can be used to locate defective parts. The entire circuit block is always active, even in the manual mode.

With full-scale output at the Buffer Amplifier, the Multiplier should have unity gain. With .316 of full-scale Buffer output, the Multiplier gain should change to 3.16.

01700-30016 ASSY-PC

AUTO SET LEVEL OPT 003

PART NO	DESCRIPTION	QTY
0100-0001	IC-OP AMP 741 U2, 3	2.0
0100-0010	IC-OP AMP 2605 GRADE 5 GREEN U1	1.0
0100-0015	IC-MULTIPLIER AD531JD U4	1.0
0200-0000	DIODE-GEN 1N914A SI CR1, 2, 4	3.0
1015-1232	RES-FXD 2.32K 1% 1/8W MF R16	1.0
1015-1499	RES-FXD 4.99K 1% 1/8W MF R4	1.0
1015-1715	RES-FXD 7.15K 1% 1/8W MF R15	1.0
1015-2100	RES-FXD 10K 1% 1/8W MF R1, 2, 3	3.0
1015-2133	RES-FXD 13.3K 1% 1/8W MF R5	1.0
1015-2200	RES-FXD 20.0K 1% 1/8W MF R8	1.0
1015-2261	RES-FXD 26.1K 1% 1/8W MF R22	1.0
1015-4100	RES-FXD 1M 1% 1/8W MF R13	1.0
1100-1100	RES-FXD 1K 5% 1/4W R18, 19	2.0
1100-1470	RES-FXD 4.7K 5% 1/4W R11	1.0
1100-2150	RES-FXD 15K 5% 1/4W R10	1.0
1100-2270	RES-FXD 27K 5% 1/4W R9	1.0
1100-3470	RES-FXD 470K 5% 1/4W R12	1.0
1410-0007	RES-VAR 20K TRIMPOT CERMET R7, 14, 20, 21	4.0
2000-0056	CAP-FXD 56PF 5% 500V MICA C4, 9	2.0
2000-0100	CAP-FXD 100PF 5% 500V MICA C14	1.0
2040-0000	CAP-FXD 0.01UF 100V CERAMIC C3, 6, 8, 11-13, 20	7.0
2040-0002	CAP-FXD 0.1UF 25V CERAMIC C18, 19	2.0
2100-0001	CAP-FXD 1UF 25V ELECT AL C15	1.0
2100-0003	CAP-FXD 10UF 25V ELECT AL C7	1.0
2100-0006	CAP-FXD 100UF 25V ELECT AL C1, 2, 16	3.0
3105-0000	SOCKET-IC 8 PIN ROUND	3.0
3105-0001	SOCKET-IC 14 PIN DIP	1.0
3400-0001	RELAY-1 FORM C K1	1.0
7200-0000	WIRE JUMPER-0.4 CTRS, PVC INSUL	1.0
7200-0001	WIRE JUMPER-0.2 CTRS, PVC INSUL	1.0
8540-0004	SCREW 6-32 X 1/4 POZI PAN HD	2.0
8542-0001	LOCKWASHER-EXT #6	2.0
8702-0002	SPACER-THD, 6-32 3/8LG X 5/16OD	2.0
01700-5016	PC BOARD-AUTO SET LEVEL OPT003	1.0

MODELS 1700B/1710B
Option 003

DISTORTION MEASUREMENT SYSTEM

WITH AUTOMATIC SET LEVEL

NEVER TOUCH
THIS KNOB AGAIN

Your system will be even faster and easier to use with automatic set level.

AUTOMATIC SET LEVEL SIMPLIFIES:

- Distortion vs. Power or Voltage Measurements
- Distortion vs. Frequency Measurements
- IHF Sensitivity Measurements in Tuners
- Distortion at Clipping Measurement in Amplifiers
- Finding the 3% Distortion Level in Tape Recorders

SOUND TECHNOLOGY

1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

Specifications

Model 1700B specifications apply with the following additions:

Capture Range: 10 dB. INPUT switch must be set for meter reading in upper 2/3 scale in VOLTS/POWER function.

Harmonic Accuracy: Add to 1700B specification

Fundamental Frequency	2nd through 5th Harmonic Accuracy
10 Hz – 20 kHz	± .2 dB
20.1 kHz – 50 kHz	± .5 dB
50.1 kHz – 110 kHz	± 1 dB

Noise: (worst case with 80 kHz filter in) .007% to 20 kHz with the measured signal greater than 0.3 vrms. Noise decreases to the standard 1700B specification as input voltage approaches full scale. Automatic Set Level can be disabled to reduce noise for high resolution readings.

All prices f.o.b. Campbell, California — data subject to change without notice.

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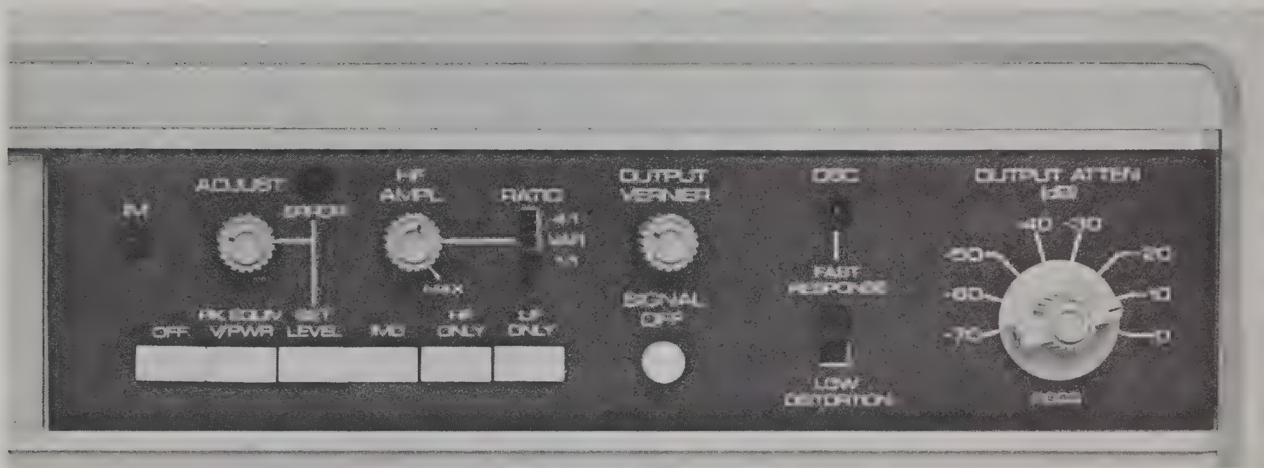
MODEL 1700B
Option 004

INTERMODULATION DISTORTION ANALYZER



Measure total harmonic distortion and intermodulation distortion with one instrument—

THIS OPTION FITS RIGHT IN THE 1700B DISTORTION MEASUREMENT SYSTEM

- Measures Intermodulation Distortion down to .0025%.
- 70 dB Output Attenuator tracks 1700B Input Switch for rapid measurements, works when measuring THD, too.
- Available with automatic set level to cover between 10 dB steps for even faster operation.
- 4:1 and 1:1 ratios are switch selectable. No HF or LF adjustment required.
- Continuously adjustable LF:HF ratio lets you choose the ratio you want using the 1700B meter.
- Measures peak equivalent single-tone voltage or power.

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Specifications

MEASUREMENT SECTION

All 1700B specifications and performance features are retained with the following additions.

Intermodulation Distortion Ranges: 0.01% to 100% full scale in 9 ranges.
Residual Intermodulation Distortion and Noise: < 0.0025% with internal generators set at 4:1 for input signals greater than 0.3V (10 mw across 8Ω). < 0.004% for input signals 0.1V to 0.3V.
Intermodulation Distortion Accuracy: ±2% full scale.
Peak Equivalent Single Tone RMS Voltage Accuracy: ±2% full scale.

GENERATOR SECTION

Output attenuator and vernier control the single tone sinewave oscillator output as well as the intermodulation distortion generator output. All 1700B oscillator specifications apply except output level control is via the attenuator and output impedance is 600Ω.

Output Voltage: 1mV to 3V open circuit, peak equivalent single tone RMS.
Output Attenuator: 70 dB in 10 dB steps, accurate within ±0.1 dB.
Output Vernier: > 10 dB range, continuously adjustable.
Output Impedance: 600Ω ±1%.
Low Frequency Generator: 50 or 60 Hz synchronized with power line. Total Harmonic Distortion < 0.1%.
High Frequency Generator: 7 kHz ±1%.
LF/HF Ratio: Switch selectable 4:1 ±1% or 1:1 ±2%. Continuously variable from 1:1 to > 100:1 with HF amplitude control.

GENERAL

Weight: Adds 5 lbs. to 1700B weight.

Data subject to change without notice.

Printed in U.S.A. 1/76

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1700B Modification Notice

0-1 INTRODUCTION

The Sound Technology Model 1700B Distortion Measurement System, first introduced in January, 1976 incorporates two design refinements not found on the 1700A. These refinements consist of two momentary front panel switches; one which replaces the oscillator signal at the SIGNAL OUTPUT jack with a floating short, and another which allows the operator to monitor the oscillator output signal with either the AC Voltmeter or Distortion Analyzer.

The reader should be aware that the terms, "1700A" and "1700B" are interchangeable as used throughout this manual.

0-1 OPERATION

a. Signal Off Switch

When depressed, this switch replaces the front panel SIGNAL OUTPUT jack with a floating short circuit. This enables the user to make signal to noise ratio measurements without the necessity of disconnecting cables.

b. Analyzer Select Switch

When this switch is depressed, the INPUT connectors are temporarily isolated and instrument is now monitoring the signal that appears at the SIGNAL OUTPUT Jack. The user may select either volts/power or DISTORTION function pushbuttons and measure the oscillator output voltage or residual distortion.

SECTION I
OPERATION

1-1. SCOPE OF SECTION

The section contains information and instructions necessary for the operation of the Sound Technology Model 1700A Distortion Measurement System. Included are power requirements, cabling information and operating instructions.

1-2. INTRODUCTION

The Model 1700A Distortion Measurement System combines an ultra-low distortion oscillator, a high-resolution automatic-measuring distortion analyzer, and an accurate ac voltage/power meter in one instrument. Pushbutton operation permits the operator to quickly measure voltage or power, set level, and then measure distortion.

The oscillator section provides a pure sine wave signal for testing from 10 Hz to 110 kHz. Amplitude is variable from 3 volts to less than 1 mV.

The analyzer section contains a tracking notch filter which is always tuned to the oscillator frequency. The analyzer measures total harmonic distortion with a sensitivity ranging from 100% to .01% full scale, with automatic nulling on all ranges. Active filters may be selected for low frequency and high frequency noise suppression, enhancing the measurement resolution. A differential front end rejects common-mode noise.

The ac voltage/power meter inherent in the analyzer measures ac voltage, or power across an 8-ohm external load. The measurement range for ac voltage is 3 mV to 300 V full scale (30 μV to 1 mV in Extended Range Para. 1-16) and for power is 1 μW to 10 kW full scale. Voltage ratio measurements with a 100 dB or more of dynamic range can also be made.

1-3. INPUT POWER REQUIREMENTS

The Model 1700A System may be operated from either a 95-125 volt or 200-250 volt, 50 to 60 Hz power source. A two-position selector switch on the rear panel selects the power source. Before connecting the instrument to the power outlet, check that the selector switch setting matches the nominal line voltage of the source.

The Model 1700A System is protected from ac power overloads by a fuse (1A, fast-blown) located in a cartridge-type fuse holder on the rear panel.

1-4. POWER CABLE

The International Electrotechnical Commission (IEC) recommends that instrument panels and cabinets be grounded to protect operating and servicing personnel. The Model 1700A system is equipped with a three-conductor power cable assembly which, when plugged into the appropriate outlet, grounds the unit through the round offset pin.

1-5. CONTROLS AND INDICATORS

The data sheet at the front of the manual illustrates and describes briefly the Model 1700A Distortion Measurement System's front panel controls and indicators. The following provides additional explanatory information:

a. POWER ON switch connects ac power to Model 1700A System. Pilot lamp glows when instrument is turned ON.

b. +INPUT and -INPUT terminals -- Provide connections for signal being measured.

c. GND (⏚) terminal -- Provides connection to chassis ground.

d. COM (⏚) terminal -- Provides connection to circuit common.

e. VOLTS/POWER pushbutton -- Selects Volts or Power measurement function.

f. INPUT switch -- Selects full scale meter range for Volts or Power measurement function. Readings are in volts rms or watts.

g. OVERLOAD indicator -- Indicator is lit when input signal overloads input buffer. This warns operator that Volts or Power measurement is no longer accurate.

h. SET LEVEL pushbutton -- Selects Set Level function whereby meter displays reference signal level for Distortion or Ratio measurement.

i. SET LEVEL ADJUST -- Adjusts reference signal level for Distortion or Ratio measurement. When control is set to CAL position (max. counterclockwise), RATIO ranges extend voltage measurement capability to 30 μV full scale (Paragraph 1-16).

j. DISTORTION pushbutton -- Selects Distortion measurement function.

k. dB VOLTS pushbutton -- Selects Ratio measurement function.

l. RATIO Switch -- Selects full scale meter range for Distortion and Ratio measurement functions. Readings are in percent or dB.

m. NOTCH FREQUENCY indicators -- Facilitate tuning when using an external oscillator. When LOW indicator is lit, Model 1700A System frequency is low with respect to incoming signal, when HIGH indicator is lit, Model 1700A System frequency is high with respect to incoming signal. System is correctly tuned when both indicators are extinguished. (It is normal for one of these indicators to glow when there is no input to the 1700A.)

n. SIGNAL COMMON switch -- Switches circuit common from chassis ground, breaking ground loops. FLOAT position floats (disconnects) circuit common of System from chassis ground; Chassis Ground (⏚) position connects circuit common of System to chassis ground.

o. FILTERS -- 400 Hz pushbutton selects a filter which suppresses low-frequency noise (such as 60 Hz hum) below 400 Hz. 80 kHz pushbutton selects a filter which suppresses high-frequency noise above 80 kHz. The 80 kHz filter also reduces effects of AM radio station pickup. Both filters affect meter reading only on Distortion and Ratio measurement functions. They do not affect meter reading on Volts/Power, and Set Level measurement functions. The 400 Hz filter is usable with fundamental frequencies down to 400 Hz when making distortion measurements.

p. METER -- Indicates signal level of measurement selected by Function pushbutton.

q. DISTORTION OUTPUT BNC connector -- Provides distortion product of signal being analyzed (suitable for viewing on oscilloscope) on Volts/Power, Set Level, and Distortion measurement functions. On Ratio measurement function, this output provides a scaled version of input signal. Output is 31.6 mV full scale.

r. FAST RESPONSE/LOW DISTORTION switch -- Selects operating mode of oscillator. FAST RESPONSE causes oscillator amplitude to settle quickly after a frequency change. This mode is recommended when ultra-low distortion measurements are not required, for example when making frequency response measurements. LOW DISTORTION selects full ultra-low distortion capability of oscillator. The settling time in this mode is less than 5 seconds. Actuation of FREQUENCY pushbuttons generally causes oscillator to go first to FAST RESPONSE mode and then to settle in LOW DISTORTION mode. This switch controls only the oscillator and is not connected to the distortion analyzer.

s. FAST RESPONSE indicator -- Indicates operating mode of oscillator. When lit, oscillator is in Fast Response mode and does not have ultra-low distortion.

t. FREQUENCY pushbuttons -- Simultaneously select oscillator and distortion analyzer frequency. Four Multiplier switches and 30 Digit switches permit 3-digit resolution within each range. Frequency range of Model 1700A System is 10 Hz to 109.9 kHz. One button in each row must be depressed at all times.

u. OSCILLATOR LEVEL control -- Adjusts amplitude of oscillator. Level is variable from 3 volts to below 1 millivolt. Control is single-turn logarithmic potentiometer.

v. SIGNAL OUTPUT BNC connector -- Provides oscillator output signal. Output impedance varies with setting of OSCILLATOR LEVEL control and reaches a maximum of 625 ohms at mid-range.

w. BUFFERED INPUT SIGNAL BNC connector (located on rear panel) -- Provides replica of input signal being analyzed. This signal is referenced to ground and intended to be connected to an oscilloscope.

1-6. TEST SETUP

In order to take full advantage of the unique ultra-low distortion measuring capabilities of the Model 1700A System it is extremely important that the cabling between the Model 1700A, the amplifier under test, and other test equipment be connected in compliance with the arrangement shown in Figure 1-1 and described in the following paragraphs. The connections and controls numbered in Figure 1-1 are similarly identified in the test. These connections have been found to provide the optimum test setup in most cases.

1-7. POWER CONNECTIONS

a. Check that power slide switch on rear panel of Model 1700A is set to correct position for available ac power (see Paragraph 1-3 for details).

b. Do not float the earth ground lead of the power cord of the Model 1700A. (The differential input makes this step unnecessary for breaking ground loops.)

c. Plug the Model 1700A, amplifier under test and the oscilloscope (if used) closely to each other into the ac power bus.

1-8. GROUND CONNECTIONS

a. Connect Model 1700A GND (⏚) terminal (1) to ground terminal (chassis ground) of amplifier under test.

NOTE

This reduces common mode 60-Hz potential differences and provides a path to ground for 60-Hz current that may be injected into the chassis of the amplifier under test from its own primary power circuits.

b. Connect oscilloscope (if used) to BUFFERED INPUT SIGNAL BNC connector (2) on rear panel of Model 1700A via cable (3).

NOTE

1. This output is from the differential to single-ended converter in the Model 1700A which provides a replica of the input signal. This signal is referenced to ground.

2. If a BNC cable is not used for this connection, the oscilloscope common (low) terminal must be returned to the Model 1700A System GND (⏚) terminal (1) via a direct connection (4).

c. This completes the ground connections necessary for proper Model 1700A operation.

1-9. SIGNAL CONNECTIONS

CAUTION

CONNECTING OSCILLATOR OUTPUT TO A HOT CHASSIS MAY BLOW FUSE, F2 or F3. (Fuses located on bottom of instrument. A blown fuse will make FLOAT switch ineffective and cause hum problems.)

DO NOT EXCEED THE INPUT VOLTAGES LISTED BELOW TO PREVENT BLOWING F101 AND F102.

With Input Range Switch -- 3 V and Lower.
1. 300V Below 60 Hz
2. 50 V Above 1 kHz

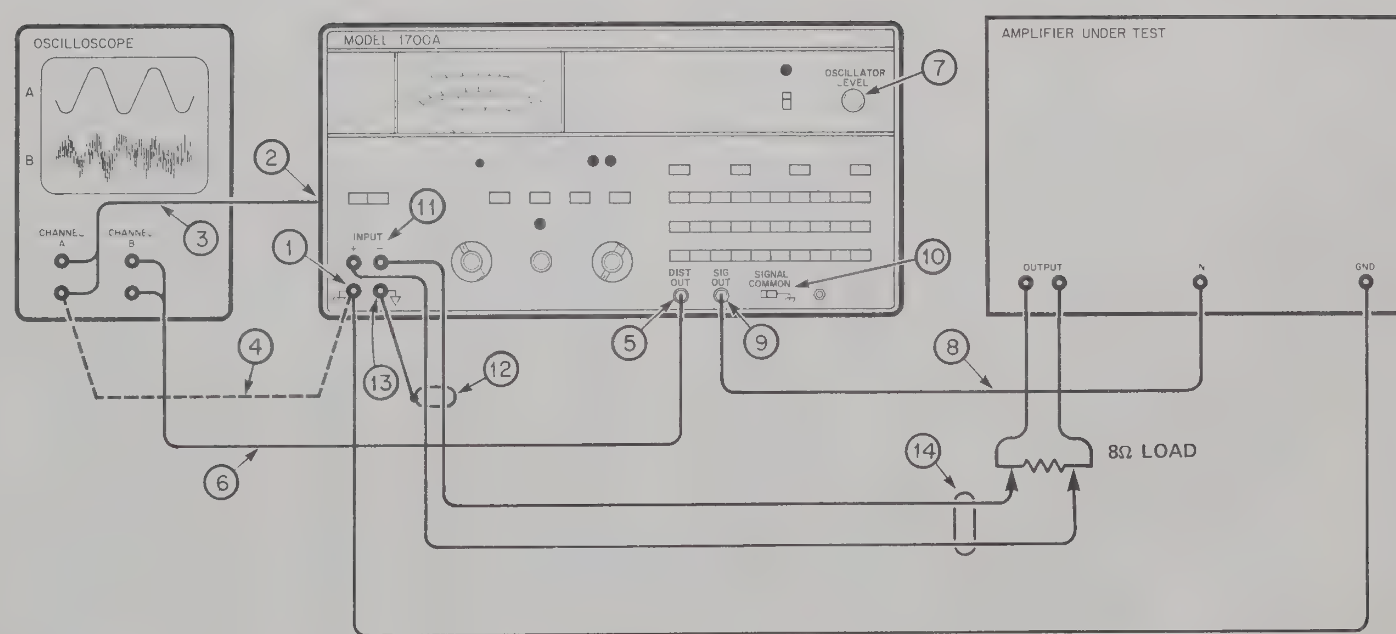


Figure 1-1 Model 1700A Test Setup

a. Connect oscilloscope (if used) to DISTORTION OUTPUT connector (5) via cable (6). This permits monitoring the distortion products of the signal being analyzed.

NOTE

The shell of the DISTORTION OUTPUT BNC connector is returned inside the Model 1700A System to circuit common through a 1 μF capacitor. The shell of the rear-panel BNC connector is at chassis ground. The above connections place this 1 μF between the Model 1700A System circuit common and the chassis when using an oscilloscope. This permits reasonably noise-free viewing of the waveforms while still retaining a considerable amount of immunity to ground loop currents flowing between the Model 1700A SIGNAL OUTPUT and the input of the amplifier under test.

b. Turn OSCILLATOR LEVEL control (7) fully counterclockwise (minimum level).

c. Set gain control on amplifier under test to its lowest setting.

d. Connect cable (8) between SIGNAL OUTPUT BNC connector (9) and input of amplifier under test.

e. Set SIGNAL COMMON switch (10) to FLOAT.

NOTE

This achieves the ultimate rejection of unwanted power-line related noise (especially in the leads of the input of the amplifier under test). With no other equipment such as an oscilloscope connected to the system, there is only a nominal .001 μF of capacitance between the System circuit common and chassis ground. The corresponding reactance, greater than 2 megohms at 60 Hz, effectively opens the ground loops between the Model 1700A and the amplifier under test.

f. Connect output of amplifier under test to a suitable 8 ohm load resistor. (Load resistor should be in a location free from any ac magnetic field, such as caused by a power transformer, to avoid hum pickup).

g. Connect signal to be measured (voltage developed across 8 ohm load) between +INPUT and -INPUT terminals (11). Use shielded twisted-pair cable for this connection and keep test leads as short as possible to avoid extraneous pick up from stray ac fields.

h. Connect shield (12) of input wiring to COM (⏚) terminal (13). Leave shield (14) at other end unconnected.

NOTE

1. The input terminals do not have a polarity (as indicated) for ac and may be connected either way with no damage to the amplifier under test.

2. Each INPUT terminal has its own input attenuator and buffer amplifier. Input impedance is 100 kilohm from each terminal to the Model 1700A System circuit common. The true differential input circuits of the Model 1700A System help break the ground loop that causes 60-Hz pickup on the input leads of most measuring equipment.

3. Do <u>not</u> connect one channel of the oscilloscope directly to the output of the amplifier under test as this can upset the noise rejection capability of the Model 1700A System differential input circuitry. If it is absolutely essential to monitor this signal, leave the ground lead of the scope channel disconnected from the amplifier under test.

1-10. OPERATING PROCEDURES

CAUTION

CONNECTING OSCILLATOR OUTPUT TO A HOT CHASSIS MAY BLOW FUSE, F2 or F3. (Fuses located on bottom of instrument. A blown fuse will make FLOAT switch ineffective and cause hum problems.)

DO NOT EXCEED THE INPUT VOLTAGES BELOW TO PREVENT BLOWING FUSES F101 AND F102.

With Input Range Switch -- 3V and Lower

1. 300 V Below 60 Hz
2. 50 V Above 1 kHz

1-11. TEST CONNECTIONS

Before making measurements with the Model 1700A System, ensure that the equipment has been connected as shown in Figure 1-1 and following the instructions given in Paragraphs 1-6 through 1-9.

1-12. METER MECHANICAL ZERO ADJUSTMENT

The meter is correctly zero set when the pointer rests over the zero calibration marks on the scale when the Model 1700A INPUT switch is set to 300 V, the VOLTS POWER pushbutton is depressed, and there is no input signal (input leads disconnected). To adjust the zero set proceed as follows:

a. Rotate zero adjustment screw (located on front panel below meter) until pointer is left of zero. Reverse rotation until pointer is exactly at zero.

1-13. DISTORTION MEASUREMENT

To measure the total harmonic distortion of a signal, proceed as follows:

a. Set FAST RESPONSE/LOW DISTORTION switch to LOW DISTORTION and select fundamental test frequency in Hz by depressing appropriate FREQUENCY pushbuttons.

NOTE

1. Four Multiplier pushbuttons (X1, X10, X100, X1000) and 30 Digit pushbuttons permit 3-digit resolution of frequency selection. For example, 453 Hz would be selected by depressing the following pushbuttons:

Multiplier	1st. Digit	2nd. Digit	3rd. Digit	Frequency
X10	40			40x10=400
		5		5x10= 50
			.3	.3x10= 3
				453 Hz

The "100" Digit pushbutton provides a 10% overlap in range. For example, 1010 Hz can be selected in two ways:

Multiplier	1st. Digit	2nd. Digit	3rd. Digit	Frequency
X10	100			100x10=1000
		1		1x10= 10
			0	0x10= 0
				1010 Hz
X100	10			10X100=1000
		0		0x100= 0
			.1	.1x100= 10
				1010 Hz

2. In the X1 range, operation of the frequency pushbuttons may not always cause the oscillator to go through its automatic stabilization cycle. If the oscillator amplitude appears to be unstable, momentarily set the FAST RESPONSE/LOW DISTORTION switch to the FAST RESPONSE position and then return it immediately to the LOW DISTORTION setting.

b. Depress VOLTS POWER pushbutton and set ADJUST control fully CCW to CAL position.

c. Set INPUT switch to expected range setting.

d. Adjust OSCILLATOR LEVEL control and/or gain control on amplifier under test for desired voltage/power level as indicated on Model 1700A meter. Up range INPUT switch when meter pointer passes full scale and down range when meter pointer goes below 1/3 of full scale.

NOTE

If OVERLOAD indicator lights and meter reads less than full scale, meter reading is incorrect due to ADJUST control being incorrectly set. To regain accuracy, turn ADJUST control down (CCW) until OVERLOAD light is OFF.

e. Depress SET LEVEL pushbutton and rotate set level ADJUST control until meter pointer rests on SET LEVEL mark.

f. Depress DISTORTION pushbutton and rotate RATIO switch until meter pointer reaches upper 2/3's of scale. If desired, depress 400 Hz and/or 80 kHz FILTER pushbutton to filter noise from input signal.

g. Observe distortion either in percentage or dB, as indicated by meter deflection and RATIO switch setting. For example, if meter reads .67 and RATIO setting is .1%, distortion measured is .067%.

1-14. DISTORTION MEASUREMENT WITH EXTERNAL OSCILLATOR

a. Connect equipment as shown in Figure 1-1, with the following exceptions:

   1. Connect power cord of external oscillator to power source close to source used by Model 1700A, amplifier under test, and oscilloscope.

   2. Connect output of oscillator to input of amplifier under test. The oscillator output may be floated if this gives better test results.

   3. Connect chassis of oscillator to GND (⏚) terminal on Model 1700A.

   4. Set SIGNAL COMMON switch on Model 1700A to ⏚ (ground) position.

b. Set external oscillator to desired frequency and signal level.

c. Preset Model 1700A FREQUENCY pushbuttons to approximate frequency of external oscillator.

d. Set ADJUST control fully counterclockwise (CCW) to CAL position and depress VOLTS POWER pushbutton.

e. Set INPUT switch to expected range.

f. Adjust external oscillator amplitude control and/or gain control of amplifier under test for desired voltage/power level as indicated on Model 1700A meter.

g. Depress SET LEVEL pushbutton. Rotate ADJUST control until Meter pointer rests on SET LEVEL mark.

h. Set 1700A frequency or external oscillator frequency so both NOTCH FREQUENCY indicators are off and that the tuning is approximately centered.

i. Depress DISTORTION pushbutton and set RATIO switch so that meter pointer rests within upper 2/3's of scale. If desired, depress 400 Hz and/or 80 kHz pushbutton to filter noise from input signal.

j. Observe distortion in either percentage or dB, as indicated by meter deflection and RATIO range setting.

1-15. AC VOLTAGE/POWER MEASUREMENT

The Model 1700A is an accurate ac voltage/power meter over its entire frequency range. The power scale is calibrated for an 8-ohm load, which must be provided externally. Voltage may be measured directly from 3 mV to 300 V full scale and power from 1 μV to 10 kW full scale. To measure ac voltage or power, proceed as follows:

a. Ensure that the power and ground connections are as described in Paragraphs 1-7 and 1-8 respectively.

b. Connect signal to be measured between + INPUT and - INPUT terminals. Use shielded twisted-pair cable for low-level inputs. Connect shield to COM (⏚) terminal.

c. Set ADJUST control to CAL position and depress VOLTS POWER pushbutton.

d. Rotate INPUT switch for an on scale reading (pointer in upper 2/3's of scale).

NOTE

The 400 Hz and 80 kHz FILTERS do not affect readings on the ac Voltage Power measurement function.

1-16. AC VOLTAGE MEASUREMENT - EXTENDED RANGE

The sensitivity of the ac voltmeter can be extended to 30 μV full scale through the use of the RATIO switch. To obtain this increased sensitivity carry out the following steps:

a. Ensure that power and ground connections are as described in Paragraphs 1-7 and 1-8 respectively.

b. Connect signal to be measured between + INPUT and - INPUT terminals. Use shielded twisted-pair cable for signal connection. Connect shield to COM (⏚) terminal.

c. Set Model 1700A controls as follows:
dB VOLTS switch -- depressed
INPUT switch --- .3 V
ADJUST control --- CAL

d. Meter full scale sensitivity is now controlled by RATIO switch as follows:

RATIO switch	Full Scale Sensitivity
-80 dB	30 μV
-70 dB	100 μV
-60 dB	300 μV
-50 dB	1 mV

NOTE

The 400 Hz and 80 kHz FILTERS will affect meter readings in this mode of operation.

1-17. dB VOLTS MEASUREMENTS

The dB Volts function facilitates the measurement of voltage ratio, signal-to-noise ratio, and frequency response, in dB or percent. The signal-to-noise ratio measurement described below provides an example of the use of this function.

a. Ensure that power and ground connections are as described in Paragraphs 1-7 and 1-8 respectively.

b. Set ADJUST control to CAL position and depress VOLTS POWER pushbutton.

c. Set INPUT switch to expected range and adjust appropriate signal level controls for desired output signal, as indicated on meter.

d. Depress SET LEVEL pushbutton and rotate ADJUST control until meter pointer rests on 0 dB mark.

NOTE

For proper 0 dB or 100% set level, reference signal must be at least .1 V and not exceed 300 V.

e. Remove input signal to amplifier under test and replace with a short circuit across amplifier's input terminals. Set SIGNAL COMMON switch to ⏚ (ground) position.

NOTE

When the input signal to the amplifier under test is removed and replaced with a short, this floats entire Model 1700A measuring circuits. Proper grounding can be restored by setting the CIRCUIT COMMON switch to the ⏚ (ground) position.

f. Depress dB VOLTS pushbutton. Select RATIO switch range which places meter pointer in upper 2/3's of scale, Read test result in dB.

g. At end of signal-to-noise ratio measurement, return SIGNAL COMMON switch to FLOAT position.

1-18. AUDIO MEASUREMENTS

Operating instructions for performing certain audio measurements as specified by the Institute of High Fidelity (1960) are given below. For these tests, ensure that the following test conditions are maintained:

a. Line: 120 V $\pm$ 1%, 60 Hz, less than 2% total harmonic distortion.

b. Temperature: 25 $\pm$ 3^{o} C.

c. Preconditioning: Unit under test should be preconditioned for 1 hour at 1/10 rated power. (FTC requires 1/3 rated power).

d. Amplifier Gain Controls: Set to maximum.

e. Amplifier Tone Controls: Flat.

f. Amplifier Balance Control: Set to normal.

g. Test Equipment: Model 1700A exceeds all IHF requirements for test equipment accuracy.

1-19. MAXIMUM POWER OUTPUT AT RATED TOTAL HARMONIC DISTORTION AT 1 kHz

NOTE

Amplifier must be able to maintain this power for 30 seconds.

a. Set Model 1700A for frequency output 1 kHz.

b. Connect SIGNAL OUTPUT to amplifier's AUX or TAPE INPUT on all channels.

c. Set RATIO SWITCH so that amplifier's rated distortion gives maximum on-scale reading, and observe distortion products on oscilloscope.

d. Increase OSCILLATOR LEVEL setting until distortion products on oscilloscope are excessive while (1) monitoring power with VOLTS POWER pushbutton depressed and (2) keeping signal on scale with INPUT switch.

e. When excessive distortion products are present, refine measurement by adjusting OSCILLATOR OUTPUT while measuring distortion until the amplifier's rated distortion is reached.

f. Switch Model 1700A to VOLTS POWER function and determine amplifier's power output at rated distortion.

1-20. POWER BANDWIDTH

a. Maintain test setup as described in Paragraph 1-19.

b. Adjust amplifier level until power is 3 dB below rated power (1/2 power) at midband (full rated power for FTC).

c. Increase Model 1700A frequency in steps from midband while measuring distortion. Stop when distortion is equal to amplifier's specifications. This is upper power bandwidth point.

d. Repeat step c, this time decreasing Model 1700A frequency until lower power bandwidth point is found. The result may be expressed briefly (for example: Power Bandwidth = 15 Hz to 37 kHz); or it may be shown as a graph of distortion versus frequency, with power held constant at 3 dB below rated power.

1-21. HUM and NOISE or SIGNAL-to-NOISE RATIO

Make this measurement following the instructions given in Paragraph 1-17 for measuring voltage ratios. Drive the amplifier to its rated power output with gain controls set to maximum. Then remove the input and obtain a dB ratio reading as described in 1-17.

SECTION II
PRINCIPLES OF OPERATION

2-1. INTRODUCTION

The Model 1700A Distortion Measurement System consists of an ultra-low distortion oscillator, a total harmonic distortion analyzer, and a dc power supply. The system makes total harmonic distortion measurements by applying a sine-wave of ultra-low distortion from the oscillator to the input of the amplifier under test while the distortion analyzer measures the amplifier output. A tunable notch filter in the analyzer, mechanically ganged to the oscillator by the front panel frequency select switches, suppresses the fundamental signal. Automatic nulling circuitry fine tunes the notch filter and ensures that the null is retained. The signal remaining at the output of the notch filter consists of the distortion products and noise. This is displayed by an average-reading voltmeter in the analyzer. The ratio of the measured distortion components to a previously set fundamental signal reference level is defined as the total harmonic distortion and can be read out directly on the meter in percent or dB. Switchable low-frequency and high-frequency filters are provided to enhance the readout of the harmonic products.

Other features of the Model 1700A include separate Voltage and Distortion measurement range switches, separate Set Level monitoring without range changing, and automatic nulling on all ranges.

The power supply provides regulated dc voltages of +15 volts and -15 volts to power the oscillator and analyzer. Both of these supplies are internally protected against accidental short circuit.

2-2. DISTORTION ANALYZER

2-3. GENERAL DESCRIPTION

Refer to Figure 4-2 for a schematic diagram of the distortion analyzer assembly. Note that the circuit is divided into the following circuit blocks: Buffer amplifier, overlaod detector, notch filter, distortion amplifier and attenuator, amplitude null filters, function switches, and ac meter. The operation of the assembly is discussed first at a circuit block level and is then followed by details of each block.

In operation, the signal to be measured is connected to the input of the buffer amplifier. This circuit has two outputs: a fixed output which may be connected to the ac voltmeter, and a variable output (controlled by the ADJUST control) which is connected to the notch filter. The voltmeter is an average reading type which measures the signal level selected by the appropriate function switch.

The overload detector monitors the variable output of the buffer amplifier. If an excessively high output voltage is detected, the detector turns on the front panel OVERLOAD indicator.

The notch filter is mechanically ganged to the oscillator frequency select switches and suppresses the fundamental from the output of the buffer amplifier. The output of the notch filter is connected to the input of the distortion amplifier through a step attenuator controlled by the front panel RATIO switch. The attenuator adjusts signal level for the distortion amplifier for various percentages of distortion or ratio readings.

The amplitude null control and phase null control circuits supply the notch filter with its automatic nulling feature. Both circuits monitor the output of the distortion amplifier and feed control signals back to the notch filter.

The sum-point buffer supplies reference signals to the tuning indicator and to the amplitude null control circuit.

The tuning indicator circuit, using frequency information from the notch filter, provides the operator with a visual indication of the frequency being analyzed versus the input frequency. This circuit operates the NOTCH FILTER HIGH and LOW indicators.

The switchable low-frequency and high-frequency filters are connected to the output of the distortion amplifier. This permits them to be selected for DISTORTION and dB VOLTS measurements only.

The switchable low-frequency and high-frequency filters are connected to the output of the distortion amplifier. This permits them to be selected for DISTORTION and dB VOLTS measurements only.

The function switches select the circuit to be measured by the ac voltmeter. When the VOLTS POWER switch is depressed, the meter monitors the output via a stepped attenuator from the buffer amplifier. When the SET LEVEL switch is depressed, the meter monitors the variable output of the buffer amplifier. Operation of the DISTORTION switch routes the signal from the distortion amplifier via the low-frequency and high-frequency filters (if selected) to the meter. When the dB VOLTS switch is depressed, it connects the variable output from the buffer amplifier directly to the attenuator at the input of the distortion amplifier and hence to the meter.

2-4. BUFFER AMPLIFIER

The input of the buffer amplifier contains a pair of step attenuators, one for each INPUT connector. The attenuators are controlled by Sections S1A, B C, D of the INPUT switch. The attenuator outputs are connected to input signal preamp ifiers U101 and U102. The gain of these units is controlled by section S1E of the INPUT switch. Gain is unity on the 3 V range and above, 3.16 on the 1 V range, and 10 on the .3 V range and below. The preamplifier outputs are coupled to U103, a bridge amplifier circuit which effectively acts as a differential to single-ended converter with high common-mode noise rejection. The gain of the bridge amplifier is controlled by ADJUST potentiometer R125 and provides the variable signal supplied by the buffer. The range of gain is 10 dB and full scale voltage is 3.16 volts. The fixed output from the buffer is obtained between the wiper of R125 and ground. This signal remains fixed regardless of the setting of R125, except when the buffer overloads.

2-5. OVERLOAD DETECTOR

The overload detector signals an overload condition when the variable output of the buffer amplifier exceeds approximately 6.5 volts rms sine wave or 9 volts peak. The circuit consists of comparator U107, a half-wave rectifier and filter, a light-emitting diode driver, and OVERLOAD indicator CR120.

2-6. NOTCH FILTER

The notch filter consists of two 90-degree phase shifters connected in series, making the output 180 degrees out of phase with the input. By summing the input and output at summing amplifier U203, the fundamental of the input signal is cancelled out. Feedback from the output of the summing amplifier to the input of the filter increases the Q of the circuit and narrows the rejection band of the filter.

Tuning is controlled by changing a set of RC elements for each phase shifter through operation of the front panel Multiplier and Digit pushbutton switches. When the reactance of the capacitance equals the resistance at the incoming frequency, the phase shift is 90 degrees. The RC components are contained in the frequency module (see Figure 4-5 for schematic diagram).

2-7. DISTORTION AMPLIFIER AND ATTENUATOR

The output of the notch filter is coupled through a 7-step attenuator to the input of distortion amplifier U204. The attenuator is controlled by section S2D of the front panel RATIO switch and reduces the distortion product of the notch filter such that the full scale voltage input to the amplifier is 1 mV on ranges .03% through 100% and .316 mV on the .01% range.

Amplifier U204 is a wide-band high-gain unit with gain controlled by section S2E of the RATIO switch. The gain is 31.6 for ranges .03% through 100% and 100 for the .01% range. This gives a full scale output voltage of 31.6 mV on all ranges.

2-8. AMPLITUDE NULL CONTROL

The amplitude null control circuit controls the amplitude of the signal from the cascaded phase shifter so that exact balance occurs when it is summed with the input to the phase shifters. This ensures the total cancellation of the fundamental signal. The components which perform this function include phase detector U310, floating integrator and voltage follower U312, integrating amplifier U311, integrating capacitors, and a photocoupler controlling a variable resistor element in the summing network.

The reference input to phase detector U310 is a signal which is in phase with the fundamental and the signal input to U310 is the distortion product output of the distortion amplifier. With these inputs, the phase detector monitors the notch filter output for an in-phase signal. When this occurs the output of the phase detector supplies drive to the integrator causing the charge on the integrating capacitors to change. This in turn causes the photocoupler to change the value of the variable resistor which in effect adjusts the summing current until the in-phase component is no longer there.

The integrating capacitors are changed by the RATIO attenuator switch. This in effect maintains the automatic null control loop gain at a relatively constant level, resulting in high-speed nulling on all ranges. The capacitors are precharged to the integrator output voltage level through resistor R360. This avoids switching transients and improves the speed of the circuit.

2-9. PHASE NULL CONTROL

The phase null control circuit fine tunes the phase of the second phase shifter in the notch filter so that the overall phase shift is exactly 180 degrees. This ensures total cancellation of the fundamental signal. The components which perform this function include phase detector U307, floating integrator and voltage follower U309, integrating capacitors, and a photocoupler controlling a variable resistor in the resistive branch of the second phase shifter.

The reference input to phase detector U307 is the distortion product output of the distortion amplifier. With these inputs the phase detector monitors the notch filter output for an out-of-phase signal. When this occurs, the phase detector output supplies drive to the integrator causing the charge on the integrating capacitors to change. The integrator output drives the variable gain amplifier, U313, and the voltage to current converter, U314, which in turn causes the photocoupler to change the value of the variable resistor which in effect adjusts the phase angle until the out-of-phase component is no longer there.

The integrating capacitors are changed by the RATIO attenuator switch. This in effect maintains the automatic null control loop gain at a relatively constant level, resulting in high-speed nulling on all ranges. The capacitors are precharged to the integrator output voltage level through resistor R344. This avoids switching transients and improves the speed of the circuit.

A set of resistors that feed signal from integrator U308 to U313, which acts as a gain control,is switched by the front panel FREQUENCY switches. This maintains a relatively constant integrator voltage when frequency is changed and helps to achieve perfect nulling in less than 5 seconds.

2-10. SUM-POINT BUFFER

The sum-point buffer supplies a signal from the notch filter summing point to the tuning indicator and the amplitude null control, each of which uses the signal as the reference input to a phase detector. The buffer consists of unity-gain amplifier U301 and high-gain high-speed amplifier U302. These components convert the sine wave at the summing point into a square wave signal.

2-11. TUNING INDICATOR

The tuning indicator monitors the phase relationship between the signal input to the notch filter's first phase shifter and its output. The relationship is frequency dependent and is 90 degrees when the incoming frequency is exactly the same as the tuned frequency of the notch filter. The components performing this function include phase detector U303, high-speed amplifier/drivers U304, U305 and HIGH and LOW indicators CR301, CR302.

The reference input to phase detector U303 is the signal at the input to the phase shifter (connected via the sum-point buffer) and the signal input to U303 is the output of the phase shifter. When the incoming frequency is exactly the same as the tuned frequency of the notch filter (90-degree phase relationship), there is no output from the phase detector. Under these conditions both indicators are off. However, if the frequency of the notch filter is high compared with the input frequency, U303 produces a dc output which turns on the HIGH indicator. Conversely, if the frequency of the notch filter is low compared with the input frequency, a dc output of the opposite polarity from U303 turns on the LOW indicator.

2-12. FILTERS

Each filter is an active 3-pole Butterworth having a flat response within its passband and an attenuation slope of -18 dB/octave. The -3 dB point is 80 kHz for the low-pass filter and 400 Hz for the high-pass filter.

2-13. FUNCTION SWITCHES

The function switches select the circuit to be measured by the ac voltmeter. When the VOLTS POWER switch is depressed the meter monitors the fixed output, via a step attenuator, from the buffer amplifier. When the SET LEVEL switch is depressed, the meter monitors the signal from a divider connected to the variable output of the buffer amplifier. Operation of the DISTORTION switch routes the signal from the distortion amplifier via the low-frequency and high-frequency filters (if selected) to the meter. This connection is not made directly by the DISTORTION switch but by the release of the SET LEVEL and VOLTS POWER switches which occurs automatically when the DISTORTION switch is depressed. When the dB VOLTS switch is depressed, it connects the variable output from the buffer amplifier directly to the attenuator at the input of the distortion amplifier and hence to the meter.

2-14. AC METER

The ac meter circuit consists of high-gain wide-band amplifier U104, a full-wave bridge rectifier circuit, and dc milliammeter M1. It indicates the average value of an ac signal. The input sensitivity is 31.6 mV full scale. The gain of the meter is adjusted by potentiometer R157.

2-15. OSCILLATOR

2-16. GENERAL DESCRIPTION

Refer to Figure 4-4 for a schematic diagram of the oscillator assembly. The oscillator is basically a Wein bridge type with a unique ultra-low distortion amplitude control circuit. This control circuit provides (1) wide frequency range (2) fast settling (3) flat frequency response and (4) ultra-low distortion. No one of these characteristics is sacrificed in order to achieve an improvement in the others.

The oscillator has two operating modes - Fast Response and Low Distortion. When Fast Response is selected the oscillator amplitude settles quickly after a frequency change; when Low Distortion is chosen, the oscillator settling time to .002% distortion is less than 5 seconds. Built-in control circuitry automatically guides the oscillator through these modes whenever there's disturbance to the amplitude, for example, a change of frequency setting.

2-17. OSCILLATOR CIRCUIT

The basic Wein bridge oscillator consists of a reactive positive feedback network and a resistive negative feedback network, both of which are tied to the output of oscillator amplifier U1. The positive feedback network feeds back to the positive terminal of the amplifier and the negative feedback network is coupled to the negative terminal of the amplifier. Frequency of oscillation is determined in the positive feedback network by the relationship:

$$f = \frac{1}{2 \pi RC}$$

Where front panel Multiplier switches change a set of capacitors for each frequency range and the Digit switches change the resistance value. These components are located in the frequency module (see Figure 4-5 for schematic diagram).

2-18. AMPLITUDE CONTROL

The ultra-low distortion amplitude control circuit consists of two control loops: A high-speed loop and a low-speed loop. These two loops, acting together, effectively vary the negative feedback ratio to regulate the oscillator amplitude.

The high-speed loop, composed of the following major components, stabilizes the oscillator from cycle to cycle.

a. Peak Detector Q2, Q3.

b. Active RC filter U2 and associated RC element.

c. Voltage-controlled resistor (VCR) Q1.

The low-speed loop, consisting of the following major components, monitors the bias applied to the VCR and ensures that the bias is always at an optimum value for low distortion.

a. Comparator R17, R18 (these components are also input resistors for integrator U3).

b. Integrator U3 and associated integrating capacitor.

c. Photocoupler U7.

In the following circuit description, assume that the oscillator has been set for Fast Response operation. In this mode relays K1 and K2 are de-energized, resulting in the following circuit conditions:

a. The time constant for active RC filter U2 is relatively short.

b. The time constant for integrator U3 is relatively short.

c. A high value of resistance is connected in parallel with the VCR section of the negative feedback loop. This allows the VCR to have a wide control range.

In operation, when power is first applied to the unit, there is no input from the oscillator. This causes the output of RC filter U2 to be zero and VCR Q1 to be at its lowest resistance. At the same time, the output of integrator U3 is also zero, which cuts off the drive to the light source in U7. This causes the photoresistor to have a very high resistance. These conditions result in a very low negative feedback ratio in the oscillator, causing it to start immediately after power is applied.

When the oscillator amplitude passes a reference voltage (voltage V2 across R15) at peak detector Q2, Q3, the detector produces an output current which starts to charge up RC filter U2. This in turn creates a large bias voltage (V1) to the VCR which increases its resistance. This tends to lower the amplitude of the oscillator. At the same time, comparator R17, R18 detects that voltage V1 is increasing and when it becomes greater than its reference voltage (V3), the comparator produces a current which drives integrator U3 to turn on the light source in U7. The photoresistor responds by decreasing its resistance, tending to further dampen the amplitude of the oscillator. This action continues until (1) The oscillator amplitude equals the reference voltage (V2) and (2) the VCR bias voltage (V1) equals the reference voltage (V3).

After the oscillator has reached a steady state condition, the circuit continues to operate as follows: Any time the oscillator amplitude is lower than the reference voltage (V2), the ac peak detector Q2, Q3 reduces drive to the RC filter and VCR. This in turn causes the VCR to decrease its resistance, bringing the oscillator amplitude back to the reference level (V2). If the oscillator amplitude is higher than the reference, a reverse action increases the VCR resistance. This operation occurs once per cycle and is performed by the high-speed loop.

The bias (V1) on the VCR is constantly monitored by comparator R17, R18 against reference voltage V3. Any difference in voltage level results in a current of corresponding polarity. This current is integrated constantly by integrator U3. Over a given period of time, if there is an average net increase of VCR bias, there will be an increase of drive to the light source of U7. (The opposite is true for a net decrease of VCR bias). This increase in drive to the light source will result in a decrease of resistance in photoresistor U7. When this occurs, the VCR is no longer required to have such a high resistance and hence high bias voltage V1. Therefore, the bias voltage (V1) for the VCR will gradually return to its predetermined value, the reference voltage V3. This action, which provides a constant optimum bias for the VCR, is performed by the low-speed loop.

Now assume that the oscillator has been set for Low Distortion operation and it is in a steady state condition. At this time, relays K1 and K2 are energized resulting in the following circuit conditions:

a. The time constant for active RC filter U2 is now longer. This filters the sawtooth voltage driving VCR Q1 to almost a dc level, minimizing its distortion effect.

b. The time constant for integrator U3 is now longer. This ensures that the stability of the control system is maintained.

c. Resistor R8 is shunted in parallel with VCR Q1. This greatly limits the control range of the VCR, reducing its distortion effort.

The oscillator remains in this state until a disturbance to the oscillator amplitude occurs. At this time, the high-speed loop, in an attempt to maintain the oscillator amplitude, creates an abnormal bias level for VCR Q1. This level is sensed by level detector Q4, Q5 which in turn triggers one-shots U6A, U6B with the result that relays K1 and K2 are de-energized. This places the amplitude control system in the Fast Response mode previously discussed. The system remains in this state for 2½ seconds.

At the end of the 2½ second interval, relay K1 is energized. This causes the following circuit action:

a. A shunt is placed across VCR Q1 to limit its control range.

b. The time constant of integrator U3 is increased to maintain circuit stability.

c. A large capacitor is allowed to charge to the steady state output value of active RC filter U2.

d. A large capacitor is allowed to charge to the steady state output value of integrator U3.

During this intermediate state, which also lasts 2½ seconds, the oscillator settles to a steady state condition. At the end of this interval, relay K2 is energized. This causes the following circuit action:

a. The precharged capacitor is connected across RC filter U2.

b. The precharged capacitor is connected across the integrator U3.

Thus, after 5 seconds, the control system is back in the ultra-low distortion mode with relays K1 and K2 energized.

2-19. POWER SUPPLY

2-20. GENERAL DESCRIPTION

Refer to Figure 4-7 for a schematic diagram of the power supply. The assembly consists of a regulated +15 Vdc supply and a regulated -15 Vdc supply, both of which feature current foldback and current limiting.

2-21. INPUT CURCUIT

Main power is coupled to the primary of transformer T1 via POWER switch S3, 115/230 Vac select switch S5, and fuse F1. Transformer T1 steps the main voltage down to the appropriate level for the individual power supply circuits.

2-22. +15 Vdc SUPPLY

Full wave rectifier CR601-604 and filter capacitor C601, connected to a secondary winding on T1, produce an unregulated output of approximately +28 Vdc. The regulation circuit includes pass element Q601, and integrated circuit regulator U601. Potentiometer R603 allows the output to be set to axactly +15 Vdc.

2-23. -15 Vdc SUPPLY

The -15 Vdc supply is similar to the +15 Vdc supply described above except that the outputs are reversed, resulting in a negative potential with respect to power supply ground. Also, the output of this supply is not adjustable.

SECTION III
MAINTENANCE

3-1. INTRODUCTION

This section provides performance checks, adjustment and calibration procedures, troubleshooting techniques, and repair instructions for the Model 1700A.

3-2. TEST EQUIPMENT

Recommended test equipment for performance checking and troubleshooting is listed in Table 3-1. Test instruments other than those described can be used provided their specifications equal or exceed those listed.

3-3. PERFORMANCE CHECK

CAUTION

Due to the ultra-low distortion characteristics of the Model 1700A, only test equipment with the specifications described in Table 3-1 is capable of making the distortion measurements called for in this check. Use of test equipment with equal or higher residual distortion to measure, for example, the low distortion oscillator, will result in erroneous readings due to:

a. Residual distortion of measuring equipment.

b. Reinforcement or cancellation effect of distortion products.

3-4. GENERAL INFORMATION

This check can be used as an incoming inspection check and the Overall System Check portion (Paragraph 3-5) can be used as a quick method of verifying correct system operation. If the correct results are not obtained, refer to the information contained in Troubleshooting (Paragraph 3-29).

Before beginning the check, ensure that all external equipment (oscilloscope, amplifier under test, etc.) is completely disconnected from the Model 1700A. Also ensure that none of the fuses described in paragraph 3-29 are blown.

3-5. OVERALL SYSTEM CHECK

3-6. Distortion Test

NOTE

1. Before beginning the test, ensure that all external equipment is completely disconnected from the Model 1700A.

2. This test measures the overall distortion of the system, with distortion from both the oscillator and the distortion analyzer contributing to the result. To measure the distortion of the analyzer assembly, an extremely pure source with a distortion of .0002% is required.

a. Connect cable between SIGNAL OUTPUT BNC connector and INPUT terminals. Use - (minus) terminal for BNC shell.

b. Set Model 1700A controls as follows:

SIGNAL COMMON switch------------------------------------ ⏚
INPUT switch-- 3 V
ADJUST control-- CAL
OSCILLATOR LEVEL control-------------------------------- fully CW (max. level)
FAST RESPONSE/LOW DISTORTION switch--------------------- LOW DISTORTION
FREQUENCY pushbutton------------------------------------ X10
100 = 1000 Hz
FILTERS pushbuttons------------------------------------- 80 kHz

Table 3-1 Required Test Equipment

TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED MODEL
AC Calibrator	Voltages: 316.2 mV, 1.000 mV, 3.162 V rms Accuracy: ± .1% at 1 kHz	Adjustment and Calibration	Fluke Model 5200A (*See alternate method described below).
Digital Multi-Meter	DC Voltage Range: 200 mV to 200 V ± .1% AC Voltage Range: 200 mV to 200 V ± .5% Resistance Range: 200 ohms to 20 M ohms ± .2%	Adjustment and Calibration Troubleshooting	Fluke Model 8000A
Frequency Counter	Frequency Range: 10 Hz to 110 kHz Period Measurements: 10 Hz to 1 kHz Accuracy: ± .1%	Adjustment and Calibration Troubleshooting	Fluke Model 1900A
Oscilloscope	Bandwidth: DC to 10 mHz Vertical: Dual Channel	Adjustment and Calibration Troubleshooting	Hewlett-Packard Model 1220A or Philips Model PM3232
Oscillator and THD Analyzer	Frequency Range: 10 Hz to 110 kHz Residual Distortion: .002%, 10 Hz to 10 kHz	Troubleshooting	Sound Technology Model 1700A

*To produce fairly accurate AC voltages: For 3.00 Vrms -- Monitor oscillator output with Digital Multimeter.

For 1.000 Vrms -- Set 1700A under test to 100 V range and set oscillator output for a 31.6 mV rms output with Digital Multimeter.

For .3162 mVrms -- Same as above except set 1700A under test to 300 V range.

c. Depress SET LEVEL pushbutton and rotate ADJUST control until meter pointer is over SET LEVEL mark.

d. Depress DISTORTION pushbutton and set RATIO switch to .01 range. Check that distortion reading is less than .004%.

e. Select following oscillator frequencies and check that distortion reading for each is less than percentage given.

Multiplier	Digit	Frequency	Distortion
X10	10	100 Hz	.004
X1	10	10 Hz	.0045
X1	100	100 Hz	.004
X100	100	10 kHz	.004
X100	10	1 kHz	.004
X1000	10	10 kHz	.004

f. Set RATIO switch to .03 range and change oscillator frequency to 100 kHz (X1000 and 100 pushbuttons).

g. Release 80 kHz FILTER pushbutton. Check that distortion reading is less than .2%.

3-7. Circuit Common Isolation Check

a. Disconnect all cables from Model 1700A and set POWER switch to OFF.

b. Measure resistance between GND (⏚) and COM (▽) terminals for each setting of SIGNAL COMMON switch. Check that readings are within tolerance given below:

SIGNAL COMMON switch	Resistance
FLOAT	>10 megohm
⏚	<0.5 ohm

c. Set SIGNAL COMMON switch to ⏚ position and reconnect cable between SIGNAL OUTPUT and INPUT terminals. Set POWER switch to ON.

3-8. OSCILLATOR CHECK

3-9. Frequency Test

a. Set Model 1700A controls as follows:

OSCILLATOR LEVEL control------------------------------ fully CW
FAST RESPONSE/LOW DISTORTION switch-------------------- FAST RESPONSE
FREQUENCY pushbuttons---------------------------------- X10, 100 = 1 kHz

b. Connect SIGNAL OUTPUT BNC connector to frequency counter and wide-band ac voltmeter. Measure amplitude of oscillator output. Check that it exceeds 3 volts.

c. Select following oscillator frequencies and check that (1) frequency is $\pm$ 2% of set value and (2) frequency response is flat within 0.2 dB.

NOTE

The Model 1700A can be used to measure the ac voltage. If this is done, the drop in response at 10 Hz is caused by the characteristics of the voltmeter and not the oscillator.

Multiplier	Digit*	Frequency
X10	10	100 Hz
X1	10	10 Hz
X1	100	100 Hz
X100	100	10 kHz
X100	10	1 kHz
X1000	10	10 kHz

*Set remaining digits to 0.

3-10. Distortion Test

a. Set FAST RESPONSE/LOW DISTORTION Switch to LOW DISTORTION and set ADJUST control to CAL.

b. Measure distortion of oscillator at frequencies listed in Paragraph 3-9.

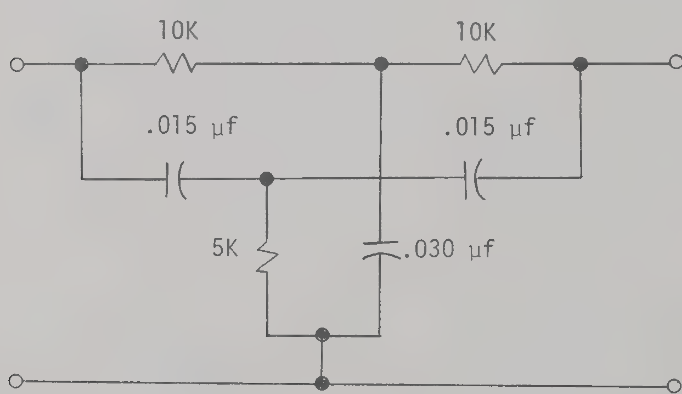
NOTE

The measurement technique for making oscillator distortion measurements (and the accuracy of the reading) depends on the type of test equipment available to the user. In general, this equipment will fall into the following three categories, listed below in order of measurement accuracy:

1. Model 1700A. In the absence of a wave analyzer, the Model 1700A can be used to make a rough check of the oscillator's distortion. Carry out the Distortion Test described in Paragraph 3-6.

2. Wave analyzer with a residual distortion of less than -60 dB. Set the Model 1700A to the 3V range and adjust the OSCILLATOR LEVEL control for a set level mark of -10 dB. Then use the wave analyzer to sort out the harmonic distortion products of the oscillator. This measurement is, in general, accurate to approximately .0005%.

3. Wave analyzer with a residual distortion of less than -80 dB. Set the oscillator output as described in 2 above. Connect a twin-T filter, which must attenuate the fundamental by at least 40 dB, ahead of the wave analyzer. Then use the wave analyzer to sort out the harmonic distortion products. This method is, in general, accurate to .0001% or 1 ppm. A suitable twin-T network for 1.06 kHz is shown in Figure 3-2.



Correction Factors For Harmonics:

2nd.	2.8
3rd.	1.8
4th	1.5

NOTE: All resistors are metal-film type, ± 1% tolerance
All capacitors are polystyrene type, ± 1% tolerance

FIG. 3-2

3-11. DISTORTION ANALYZER CHECK

3-12. dB Volts Test

a. Set Model 1700A controls as follows:

INPUT switch	30 V
OSCILLATOR LEVEL control	fully CCW
FAST RESPONSE/LOW DISTORTION switch	LOW DISTORTION
LOW DISTORTION switch	X10 100 = 1000 Hz
RATIO switch	.01
SIGNAL COMMON switch	

b. Depress dB VOLTS pushbutton and adjust OSCILLATOR LEVEL control for full scale reading on meter.

c. Set RATIO switch to next higher range and check that signal drops by approximately 10 dB.

d. Again adjust OSCILLATOR LEVEL control for a full scale reading and then set RATIO switch to next higher range. Check that signal again drops by approximately 10 dB.

e. Repeat this operation until a -10 dB reading on 10% range is reached. At this time, set OSCILLATOR LEVEL control fully clockwise and then rotate ADJUST control for a full scale reading.

f. Set RATIO switch to 30% range and check that signal drops approximately 10 dB.

Rotate ADJUST control for full-scale reading. Set RATIO switch to 100% range. Check that signal drops approximately 10 dB.

3-13. Volts Power Test

a. Set Model 1700A controls as follows:

INPUT switch	.003 V
ADJUST control	CAL
OSCILLATOR LEVEL control	fully CCW
FAST RESPONSE/LOW DISTORTION switch	FAST RESPONSE
FREQUENCY pushbuttons	X10 100 = 1000 Hz
SIGNAL COMMON switch	⏚

b. Depress VOLTS POWER pushbutton and adjust OSCILLATOR LEVEL control until meter pointer indicates full scale.

c. Set INPUT switch to next higher range and check that signal drops by approximately 10 dB.

d. Again adjust OSCILLATOR LEVEL control for a full scale reading and then set INPUT switch to next higher range. Check that signal again drops by approximately 10 dB.

e. Repeat this operation until 3 volt range is reached. At this time turn OSCILLATOR LEVEL control fully clockwise. Now up range INPUT switch through the remainder of its ranges, checking that signal drops by approximately 10 dB on each range.

3-14. Filters Test

a. Set Model 1700A controls as follows:

INPUT switch	3 V
ADJUST control	CAL
OSCILLATOR LEVEL control	fully CW
FAST RESPONSE/LOW DISTORTION switch	LOW DISTORTION
FREQUENCY pushbuttons	X10 40 = 400 Hz
RATIO switch	0 dB
SIGNAL COMMON switch	⏚

b. Depress dB VOLTS pushbutton and set ADJUST control for a 0 dB meter reading.

c. Depress 400 Hz FILTERS pushbutton. Check meter for a -3 dB reading.

d. Release 400 Hz FILTERS pushbutton.

e. Set oscillator frequency to 80 kHz (depress X1000 and 80 pushbuttons) and depress 80 kHz FILTERS pushbutton. Check that signal attenuation is -3 dB or more.

3-15. Residual Noise Test

a. Set Model 1700A controls as follows:

INPUT switch	3 V
ADJUST control	CAL
OSCILLATOR LEVEL control	fully CW
FAST RESPONSE/LOW DISTORTION switch	LOW DISTORTION
FREQUENCY pushbuttons	X10 100 = 1000 Hz
FILTERS pushbuttons	80 kHz
SIGNAL COMMON switch	⏚

b. Depress SET LEVEL pushbutton and adjust OSCILLATOR LEVEL control until meter pointer is at SET LEVEL mark.

c. Depress DISTORTION pushbutton and set RATIO switch to .01 range. (This reading is noise and distortion of oscillator and analyzer).

d. Depress SET LEVEL pushbutton and adjust OSCILLATOR LEVEL control for a meter reading of -15 dB. (This greatly reduces the level of the signal input to the analyzer with the result that almost all of the distortion products are eliminated and only the residual noise of the analyzer remains).

e. Depress DISTORTION pushbutton. Check that meter reading is less than .0025%.

f. Remove cable connected between SIGNAL OUTPUT connector and INPUT terminals.

g. Place a shorting link between INPUT terminals and connect to COM (⏚) terminal.

h. Depress dB VOLTS pushbutton and set controls as follows (meter full-scale sensitivity is now 30 μV).

INPUT switch	.3 V
ADJUST control	CAL (fully CCW)
RATIO	.01%

i. Depress 80 kHz FILTERS pushbutton and check that meter reading is less than 8 μV.

j. Release 80 kHz pushbutton and check that reading is less than 15 μV.

3-16. Common Mode Rejection Test

a. Connect SIGNAL OUTPUT BNC connector to INPUT terminals and set oscillator frequency to 60 Hz (depress X1 and 60 pushbuttons).

b. Depress VOLTS POWER pushbutton and adjust OSCILLATOR LEVEL control for a meter reading of 1 volt.

c. Remove cable from INPUT terminals and short + and - INPUT terminals together. Now connect input cable between - INPUT and GND (⏚) terminals.

d. Set RATIO switch to -20 dB range and ADJUST control to CAL position.

e. Depress dB VOLTS pushbutton. Check that meter reading is -20 dB or lower.

3-17. ADJUSTMENT and CALIBRATION PROCEDURE

The following is a complete adjustment and calibration procedure for the Model 1700A. The procedure should be carried out only when the Performance check (Paragraph 3-3) indicates that adjustments are required. If the Model 1700A does not meet the test limits specified in the following steps, consult the troubleshooting information provided in Paragraph 3-29. The location of the adjustment controls in the analyzer, oscillator, and power supply are shown in Figures 4-1, 4-3, and 4-6 respectively.

3-18. OSCILLATOR SECTION

3-19. +15 Volt Adjustment

a. Connect HI lead of digital voltmeter (DVM) to +15 volt terminal and LO lead to GND terminal on power supply assembly.

b. Adjust potentiometer R603 for DVM reading of +15.000, $\pm$ .010 V.

3-20. Photocell AC Voltage Adjustment

a. Set Model 1700A controls as follows:

FREQUENCY pushbutton------------------------------------X10 / 10 = 100 Hz

FAST RESPONSE/LOW DISTORTION switch-------------------- FAST RESPONSE

b. Connect HI lead of DVM to junction of R3 and R4; connect DVM LO lead to "0" terminal (oscillator output) on oscillator board.

c. Adjust R5 for AC voltage reading of .20V.

NOTE

Clockwise rotation of R5 decreases voltage, counterclockwise rotation increases voltage.

3-21. Oscillator Integrator Voltage Change Adjustment

a. Set Model 1700A controls as follows:

FREQUENCY pushbutton------------------------------------ X10 / 10 = 100 Hz

FAST RESPONSE/LOW DISTORTION switch-------------------- FAST RESPONSE

b. Connect DVM HI lead to TP6 and LO lead to GND.

c. Connect TP3 to GND with clip lead. Note dc voltage reading on DVM.

d. Remove clip lead from TP3. Adjust potentiometer R7 for same dc voltage noted in Step c. $\pm$ .005 V.

NOTE

The following is an alternative method of measuring the TP6 voltage with a floating VTVM:

Connect LO terminal of VTVM to positive terminal of C603 on power supply board and the HI terminal to TP6. (In this case, the dc potential at C603 is used as a bucking voltage so that the VTVM can be set to a lower (move sensitive) range to resolve the required 5 mV).

3-22. Oscillator Integrator Output Adjustment

CAUTION

If the photocoupler has been replaced, allow at least 10 minutes to elapse before proceeding with this adjustment. This is to allow the unit (and the technician!) to cool off after soldering.

a. Set Model 1700A controls as follows:

FREQUENCY pushbuttons	X10 10	= 100 Hz
FAST RESPONSE/LOW DISTORTION switch	FAST RESPONSE	

b. Connect DVM HI lead to TP6 and LO lead to GND. Adjust R20 for +6.5* volts dc at TP6.

*The 6.5 V setting is for a dark adapted photocoupler. This is a photocoupler which has been in the off state for the last 24 hours (instrument power off). It is normal for the voltage at TP6 to gradually increase with time.

If the dc voltage at TP6 is greater than +8 V after the instrument has been on for 24 hours or more, readjust R20 for +8 V at TP6.

3-23. Oscillator X1000 Frequency Range Adjustment

a. Depress Model 1700A X1000 Multiplier and 1st Digit 10 FREQUENCY pushbuttons. Set 2nd and 3rd Digits to zero.

b. Monitor (1) dc voltage between TP6 and GND and (2) frequency of oscillator.

c. Adjust trimmer capacitors across C33 and C38 with an insulated trimmer tool until (1) dc voltage is in range of 6.5 V to 8 volts and (2) frequency is 10.0 kHz ± 1.5%.

d. Depress 100 Digit FREQUENCY pushbutton. Check that (1) dc voltage is in range of 6.5 to 8 volts and (2) frequency is 100 kHz ± 1.5%.

e. Repeat Steps c. and d. until voltage and frequency readings are within specifications stated.

3-24. ANALYZER SECTION

3-25. Dc Zero Adjustment

a. Connect a short between +INPUT, -INPUT and COM (⏚) terminals.

b. Set Model 1700A controls as follows:

INPUT switch-- .3 V
ADJUST control-- fully CW

c. Connect DVM HI lead to TPI and LO lead to TP2. Adjust potentiometer R219 for a DVM reading of zero volts ± 10 mV.

d. Connect DVM HI lead to negative side of capacitor C209. Adjust potentiometer R217 for DVM reading of zero volts ± 10 mV.

e. Connect DVM HI lead to TP9 (located at rear of board).

f. Set Model 1700A controls as follows:

INPUT switch-- 3 V
ADJUST control-- CAL (fully CCW)
RATIO switch-- .01

g. Adjust potentiometer R234 for reading of zero volts ± 10 mV.

3-26. Null Adjustment

a. Set Model 1700A controls as follows:

INPUT switch-- 3 V
ADJUST control-- CAL (fully CCW)
RATIO switch-- 10%
DISTORTION pushbutton------------------------------------- depressed

SIGNAL COMMON switch	⏚ (ground)
FREQUENCY pushbuttons	X10 10 = 100 Hz
OSCILLATOR LEVEL control	fully CW
LOW DISTORTION/FAST RESPONSE switch	LOW DISTORTION
FILTERS	80 kHz depressed

b. Connect cable between SIGNAL OUTPUT connector and INPUT terminals.

c. Connect one channel of oscilloscope to BUFFERED INPUT SIGNAL connector (at rear of instrument).

d. Adjust oscilloscope so that waveform is synched to Buffered Input Signal.

e. Monitor waveform at pin 6 of U312 with the other scope channel.

f. Adjust R351 for minimum fundamental signal at pin 6 of U312.

g. Now, monitor waveform at DISTORTION OUTPUT.

h. Adjust potentiometers R337 and R354 until Distortion output waveform contains no fundamental signal.

3-26A. Phase Null Integrator Voltage Adjustment

a. Set Model 1700A controls as described in Paragraph 3-6, Steps a. through d.

b. Connect DVM HI lead to TP9 and LO lead to TP6.

c. Adjust R364 for a dc voltage reading of 2.8V*.

*The 2.8V setting is for a dark adapted photocoupler. This is a photocoupler which has been in the off state for the last 24 hours (instrument power off). It is normal for the voltage at TP6 to gradually increase with time.

If the dc voltage between TP9 and TP6 is greater than 3.0 V after the instrument has been on for 24 hours or more, readjust R364 for 3.0 V.

3-27. Tuning Indicator Adjustment

a. Set Model 1700A controls as follows:

INPUT switch	3 V
ADJUST control	CAL (fully CCW)
RATIO switch	1%
FREQUENCY pushbuttons	X10 (2nd. and 3rd. digits to zero)
OSCILLATOR LEVEL control	fully CW
FAST RESPONSE/LOW DISTORTION	FAST RESPONSE
SIGNAL COMMON switch	⏚ (ground)

b. Connect DVM LO lead to green wire connected to NOTCH FREQUENCY indicators and HI lead to junction of R320 and pin 6 of U305.

c. Depress in turn each FREQUENCY 1st digit pushbutton and observe DVM voltage readings. Record (1) digit giving most positive reading and its value and (2) digit giving most negative reading and its value.

d. Depress X1 Multiplier FREQUENCY pushbutton, and repeat procedure described in Step c.

e. Depress X100 Multiplier FREQUENCY pushbutton and repeat procedure described in Step c.

f. Review all readings recorded and determine (1) most positive value and (2) most negative value. Add these two values together (to determine voltage range) and then divide number by 2 (to determine mid-point).

g. Depress digit previously determined to have most positive reading and adjust potentiometer R312 until DVM indicates mid-point value determined in Step f. See example below:

Multiplier	Most Pos. Digit	Most Neg. Digit
X10	60, + 1.0 V	50, + .20 V
X1	60, - .20 V	50, - .70 V
X100	60, + .01 V	50, - .60 V

Overall most positive = X10, 60 = + 1.0 V
Overall most negative = X1, 50 = - .70 V
Range = 1.70 V, mid-point = .85 V
Adjust X10, 60 for + .85 V

h. Depress X1000 Multiplier pushbutton and repeat Steps c. and f.

i. Now depress digit giving most positive value and using a non-metallic screwdriver, adjust trimmer capacitor accessible through hole in shield on right-hand side of instrument for mid-point value determined in repeat of step f.

3-28. Calibration at 1 kHz

a. Set Model 1700A controls as follows:

VOLTS POWER pushbutton	depressed
FILTERS	out
FREQUENCY pushbutton	X10 100 = 1 kHz
INPUT switch	3 V
ADJUST control	CAL (fully CCW)
RATIO switch	.03%
SIGNAL COMMON switch	⏚ (ground)

b. Set meter mechancial zeroing as described in Paragraph 1-12.

c. Apply an accurate 3.162 V ± 0.1% or better 1 kHz signal between +INPUT and -INPUT terminals. Connect low side of test signal to -INPUT.

d. Connect chassis of precision ac source to GND (⏚) terminal on Model 1700A.

e. Adjust Meter Sensitivity potentiometer R157 for an exact full-scale reading (1.0 mark on VOLTS scale) on meter.

f. Depress SET LEVEL pushbutton. Adjust Set Level potentiometer R146 for an exact full-scale reading.

g. Change input signal level to 1.000 mV. Depress dB VOLTS pushbutton and adjust Distortion Amplifier Gain potentiometer R237 for an exact full-scale reading.

h. Change input signal level to .3162 mV and set RATIO switch to .01%. Adjust Distortion Amplifier Gain potentiometer R239 for an exact full-scale reading.

3-29. TROUBLESHOOTING

Check the two 3AG 1 Amp fuses located on bottom of instrument.

Before attempting to troubleshoot the Model 1700A, ensure that the fault is with the Model 1700A and not caused by the test setup or associated equipment. The Performance Check (Paragraph 3-3 enables this to be determined without having to remove the covers from the Model 1700A.

If an abnormal condition is observed during the Performance Check, Table 3-2 will suggest remedies. However, before proceeding with detailed troubleshooting, note the following suggestions:

a. A good understanding of the principles of operation of the Model 1700A will assist the troubleshooter and it is recommended that the reader be familiar with the contents of Section II of this manual.

b. Any suspected malfunction should first be tested with the Performance Check. This need not be carried out in its entirety ---- only the portion applicable to the suspected malfunction need be performed.

c. Verify proper power supply operation by measuring the +15 Vdc and -15 Vdc voltages. Check also the +12, -6 and -8 Vdc supplies which operate the null control circuits on the analyzer board.

d. Many measurement problems or bad readings can be related to incorrect grounding. Refer to Paragraph 1-8 for correct grounding instructions.

e. The differential input circuitry of the Model 1700A requires a return to circuit common. Check the input cabling for proper connections.

f. Attempt to isolate the malfunction to either the oscillator or the distortion analyzer. After this, try to isolate the fault to a circuit block within the suspected unit.

g. Determine component failure within the analyzer by operating the Model 1700A without an input signal and then comparing dc levels with those marked on the schematic.

h. Since the instrument contains a number of identical components mounted in plug-in sockets, it is permissible to switch these units in order to isolate a malfunction. However, known good components <u>must</u> always be returned to their original locations.

i. Phase detector U303 in the tuning indicator need not be in position for proper notch filter operation. This component can therefore be used to isolate a malfunction in the null control circuits. But be sure to return the original I.C. to U303 when done.

j. Abnormally large potentials (more than ± 15 mV) measured between the + and - input terminals on operational amplifiers generally indicate a defective amplifier.

k. When a malfunction occurs try first to find out if the trouble relates to any particular pushbutton. If it does, it may be possible to cure the problem by depressing and releasing the defective button several times.

3-30. <u>SYMPTOM/CAUSE TABLE</u>

Table 3-2 contains symptoms of Model 1700A malfunctions and provides diagnostic tests for the location of these faults. Before beginning detailed troubleshooting, the reader is advised to study notes a. through k. in Paragraph 3-29.

Following the replacement of a defective component, refer to Paragraph 3-31 for instructions regarding any necessary calibration and/or adjustment procedures.

3-31. <u>COMPONENT REPLACEMENT - CALIBRATION and ADJUSTMENT</u>

Portions of the Model 1700A Adjustment and Calibration Procedure (Paragraphs 3-18) and other adjustments must be completed following the replacement of certain components in the instrument. These components, and the applicable Adjustment/Calibration Procedures are as listed below:

	Component	Required Adjustment/Calibration Procedure
a.	Photocoupler U7 (Oscillator)	Oscillator Integrator Output Adjustment (Paragraph 3-22)
b.	Voltage - controlled resistor Q1 (Oscillator)	Oscillator Integrator Voltage Change Adjustment (Paragraph 3-21)
c.	Operational Amplifier U1 (Oscillator)	Oscillator X1000 Frequency Range Adjustment (Paragraph 3-23)
d.	Operational Amplifiers 2605, 2625 (Analyzer)	DC Zero Adjustment - related adjustment (Paragraph 3-25)
e.	Meter M1 (Analyzer)	Calibration at 1 kHz (Paragraph 3-28)
f.	Phase detectors U307, U310 (Analyzer, null control)	Null Adjustment (Paragraph 3-26)
g.	Phase detector U303 (Analyzer, tuning Indicator)	Tuning Indicator Adjustment (Paragraph 3-27)
h.	Photocoupler U205 (Analyzer, phase null control)	Allow 10 minutes for the photocoupler to cool off after soldering. Phase Null Integrator Voltage Adjustment (Paragraph 3-26A).

i.	Photocoupler U206 (Analyzer, amplitude null control)	Allow 10 minutes for the photocoupler to cool off after soldering. Set controls as described above. Connect DVM HI lead to TP8 and LO lead to TP7. Reading is dc voltage across R359. Calculate current through it. If necessary, select new value for R359, such that 1.4 $\pm$ .2 V is developed across it. Replace R359.

3-32. REPLACEMENT and REPAIR

3-33. SPECIAL PRECAUTIONS

3-34. Contamination

The performance of the Model 1700A will be greatly degraded by contamination of the circuit-board surfaces or components. Finger marks and oil droplets are contaminants to be especially avoided. To minimize the possibility of contamination, observe the following precautions:

a. Do not disassemble any portion of the Model 1700A unless absolutely necessary (for example, to replace relays on oscillator board or to service frequency modules.)

b. Avoid any unnecessary handling of the printed-circuit boards or components. Replace components from the top side of the boards only.

c. Employ only the soldering and component replacement techniques described in Paragraphs 3-36 through 3-39.

3-35. WIRING

Lead dress within the instrument should not be altered. This is especially important with the wires running between the rotary switches and the distortion analyzer assembly. Before removing an assembly with wires attached, make a sketch showing the exact arrangement of the wires so that they may be replaced in the same manner.

3-36. SOLDERING TECHNIQUES

a. Use a low-wattage iron with a pencil-shaped tip and allow it to reach full operating temperature before use. A fully-heated iron ensures the quick completion of soldering and minimizes the chance that the etched wiring on the printed-circuit boards will be damaged by excessive heat.

b. Before using the soldering iron, wipe it off to remove excess solder and oxide.

c. Use only a solder with non-corrosive non-conductive flux. Do not use acid-cored solder.

d. Do not clean off the rosin around the soldered joint with a wire brush or metal scribe. This will destroy the high electrical resistance of the board.

3-37. COMPONENT REPLACEMENT

CAUTION

The use of Soder-Wick* (rosin-impregnated copper braid) or a similar product is highly recommended for the removal of solder during the de-soldering operation. If it is not available, and a vacuum-type de-soldering tool is employed, ensure that it is cleaned before use. This is to prevent the possibility of conductive debris being sprayed on the board during the de-soldering process.

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*Soder-Wick may be obtained from Solder Removal Company, Covina, CA, U.S.A.

Table 3-2

SYMPTOM	PROBABLE CAUSE	DIAGNOSTIC TEST
Oscillator will not settle down to low distortion mode	Photo-coupler, U7	Replace photo-coupler
	VCR, Q1	Replace VCR
	R7 out of adjustment	Do oscillator Integrator Change Adjustment (Paragraph 3-21)
	Dual Timer, U6	Replace U6
	Oscillator amp. U1	Replace U1
Oscillator has excessive unstable distortion readings	Photo-coupler, U7	Replace U7
	VCR, Q1	Replace Q1
	Oscillator amp., U1	Replace U1
Oscillator has excessive third harmonic distortion	Photo-coupler, U7	Replace U7
Oscillator produces clipped waveforms	Photo-coupler, U7	Replace U7
	RC filter amplifier, U2	Replace U2
	Integrator Amplifier, U3	Replace U3
	Oscillator Amp., U1	Replace U1
	Peak detectors, Q2, Q3	Replace Q2 or Q3
Oscillator has no output on all frequencies	Oscillator Amp., U1	Replace U1
Oscillator has hum output	Improper ground connections or Float switch set to ground (⏚) position	Check that ground and connections are in compliance with Paragraphs 1-8 and 1-9
Hum in distortion output	Missing chassis connection between 1700A and scope	Check that connections are in compliance with Paragraphs 1-8 and 1-9
Distortion reading contains excessive hum	Missing ground return for 1700A differential front end	Check that connections are in compliance with Paragraphs 1-8 and 1-9
High distortion reading under all conditions (Not Nulling)	Amplitude Null Circuit (U302, U310, U311, U312)	Check D.C. voltages on Null circuit without input signal
	Photo-coupler, U206	Replace U206
	Phase Null Circuit (U306, U307, U308, U309)	Check D.C. voltages on Null circuit without input signal
	Photo-coupler, U205	Replace U205

Table 3-2, Continued

SYMPTOM	PROBABLE CAUSE	DIAGNOSTIC TEST
High distortion reading under all conditions (Not Nulling), Cont.	Notch Filter (U201, U202, U203, U301)	Open feedback loop by lifting up one end of R203 (100 ohms). Check D.C. voltages on Notch Filter circuit without input signal
	Leaky zener diode CR304 or CR305	Disconnect zener from circuit while operating in Distortion Function
One of Notch frequency lights stays ON during measurement on all frequencies	Tuning indicator circuit (U303, U304, U305)	Check D.C. voltages on circuit without input signal
	Phase detector, U303	Replace U303
	R312 out of adjustment	Do tuning indicator adjustment (Paragraph 3-27)
Analyzer has excessive unstable distortion readings	Photo-coupler U205 or U206	Make certain the symptom is from the analyzer section and not the oscillator section. Then replace U205 or U206
One of notch frequency lights stays ON during distortion measurement on some frequencies	Oscillator frequency drifted out of $\pm$ 2% limit	Check oscillator frequency with counter
	R312 out of adjustment	Do tuning indicator adjustment (Paragraph 3-27)
	Range capacitor(s) or digit resistor(s) drifted out of tolerance in analyzer section	Unsolder range capacitor(s) from P.C. board to measure value. Check the suspected resistor(s) by actuating proper pushbutton(s) and measure at analyzer P.C. board.
Nulling becomes excessively slow	Oscillator drifted up in frequency	Check frequency with counter
	Photocoupler U205 or U206 characteristic changed causing a high integrator voltage	Do Phase Null Integrator Voltage Adjustment (Paragraph 3-26A. Check D.C. voltage at TP8 with respect to TP7. If voltage is greater than 6 volts, change R359 according to procedure described in 3-31-i. If new R359 $\leq$ 500 ohms, change U206.
Not Nulling on some frequencies	Bad contact in pushbutton switch	Refer to Troubleshooting Paragraph 3-29-k

3-38. Multi-Lead Devices

Follow the instructions given below when replacing multi-lead components on the printed-circuit boards:

a. Cut all leads to remove device from P.C. board. The pieces of the leads that remain can then be unsoldered from the board.

CAUTION

Be sure to hold each lead with needle-nose pliers when it is unsoldered. This is to prevent the possibility of a lead dropping through a hole and shorting traces below the board.

b. Using Solder-Wick, remove remaining solder from component holes.

c. When replacing a device, ensure that the length of its leads match the length of the leads on the device removed. Do not push the new device too far down into board as this may cause a short to the metal deck below. The clearance between the boards and the metal deck is 1/4 inch.

3-39. Potentiometers

The small black rectangular potentiometers are attached to the printed-circuit boards by three leads projecting from their lower surface in line with the numbers "1", "2", and "3" marked on top. To remove this type of potentiometer, proceed as follows:

a. Carefully raise side of potentiometer <u>opposite</u> numbers until leads below are visible.

b. Continue bending leads until there is sufficient clearance for tip of soldering iron.

c. Unsolder potentiometer following instructions given in Paragraph 3-38.

d. Install replacement component following reverse procedure.

3-40. Power Supply

The majority of the components on the power supply assembly may be replaced without removing the board from its location on the rear panel. However, if additional access is required proceed as follows:

a. Remove bottom cover from Model 1700A and remove retaining screws securing power supply board to rear panel.

b. Slide power supply board forward through bottom of instrument as far as wires attached to it will allow.

3-41. FREQUENCY MODULE REPAIR

3-42. General

The following procedure details step by step instructions for disassembly and repair of the instrument's frequency module. It is recommended that this procedure be closely followed and performed only by personnel familiar with electronic equipment disassembly/assembly techniques.

3-43. Removal/Replacement

CAUTION

Certain subassemblies in the instrument are secured with hardware which includes insulating washers. Note the location of these washers when disassembling the unit and replace them in the same locations on reassembly. Failure to observe this precaution will result in improper operation of the instrument.

a. Remove top and bottom covers and place instrument on clean work surface.

b. Remove four screws securing right side brace (side nearest power transformer) to front and rear panels.

c. Remove three screws securing deck and switch bracket in the bottom channel of right side brace.

d. Remove handle caps and two screws securing handle to right side brace.

e. Remove two screws securing analyzer deck to rear panel.

f. Remove two screws securing left side brace to rear panel.

g. Pull back rear panel and slide out brown handle plate on right side brace.

h. Remove screw (which was beneath brown handle plate) securing switch bracket to right side brace.

i. Remove four screws securing power supply assembly to rear panel. Move power supply to allow access to oscillator deck screws.

j. Remove two screws securing oscillator deck to center divider.

k. Remove two screws securing switch bracket to center divider.

l. Carefully withdraw oscillator portion of frequency module from instrument. Unsolder wires attached to assembly if complete removal is desired.

NOTE

The wires are color-coded for attachment to the numbered holes in the printed circuit board; black = 0, brown = 1, red = 2, orange = 3, yellow = 4, etc.

m. Remove four nuts securing analyzer portion of frequency module to front panel. Slide assembly back for access and unsolder wires if complete removal is required.

n. Replace analyzer and oscillator frequency module assemblies and reassemble instrument following reverse procedure.

NOTE

1. When replacing analyzer portion of frequency module, line up pushbuttons with openings in front panel.

2. When replacing oscillator portion of frequency module, line up pushbars vertically with the rear of the pushbars of the analyzer section. Ensure also that there is a .015 inch clearance between the analyzer and oscillator pushbars, with the pushbuttons in undepressed position. See Figure 3-2 for details.

3-44. Repair Instructions

CAUTION

Field repair of the frequency module is limited to replacement of defective RC components on the switch boards. Replacement of pushbutton switches is not recommended -- order a replacement switch board from the factory.

a. Remove bus wires running between boards, using multi-lead component desoldering technique described in this section of the manual. (paragraph 3-38)

b. Detach board containing defective components from switch bracket and replace component.

c. Reassemble module, replacing bus wires removed in step a.

NOTE

1. Spacing between boards must be 25/32 inch (inside to inside dimension) to ensure proper alignment.

2. Boards must be perpendicular to switch mounting bracket.

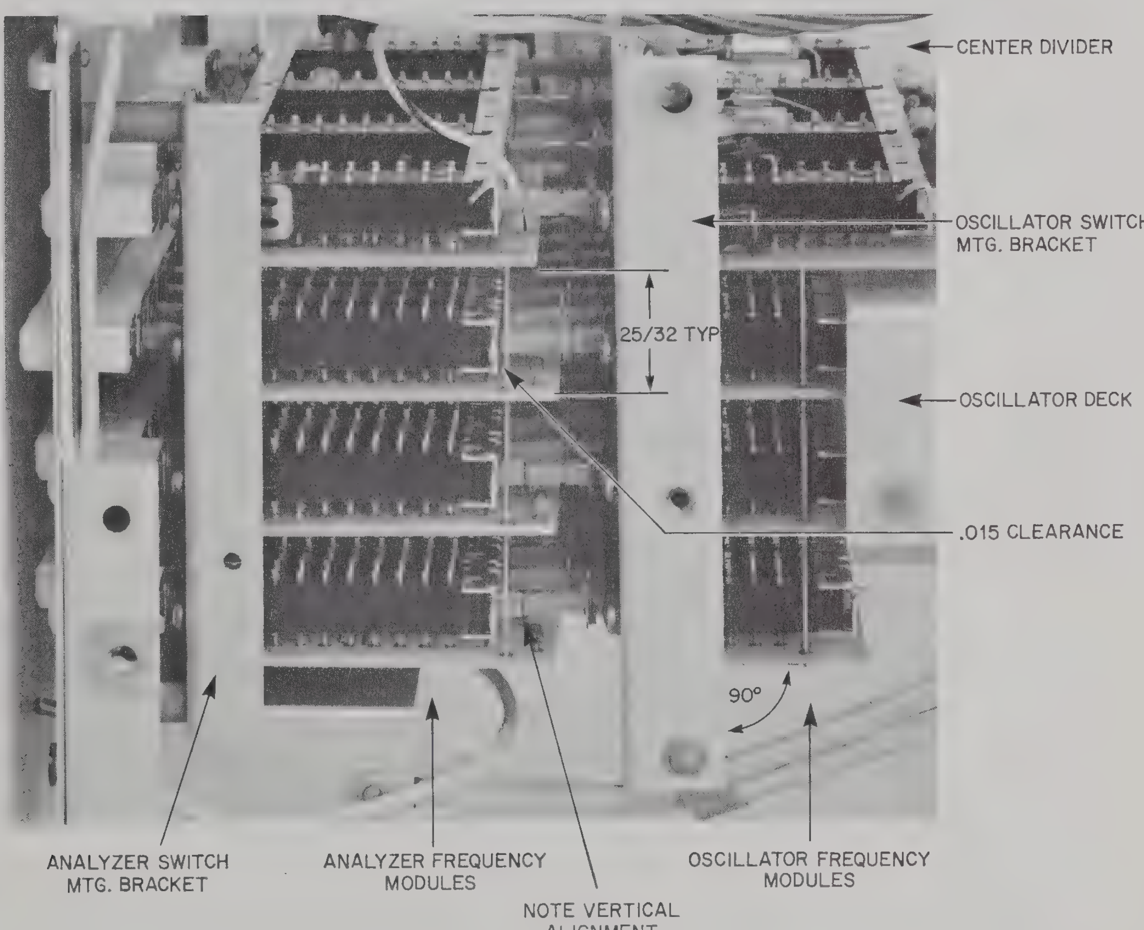


FIG. 3-2

SECTION IV
DIAGRAMS

4-1. INTRODUCTION

This section contains the circuit diagrams necessary for the operation and maintenance of the Model 1700A. Included are schematic diagrams and component location diagrams.

4-2. SCHEMATIC DIAGRAMS

The circuitry contained within each assembly is shown in the schematic diagrams. As an aid to isolating malfunctions, the diagrams also provide typical operating voltages and wave-forms.

4-3. COMPONENT LOCATION DIAGRAMS

The component location diagrams show the physical location of parts mounted on each assembly. Each part is identified by a reference designator, similarly identified on the schematic diagrams and in the parts list.

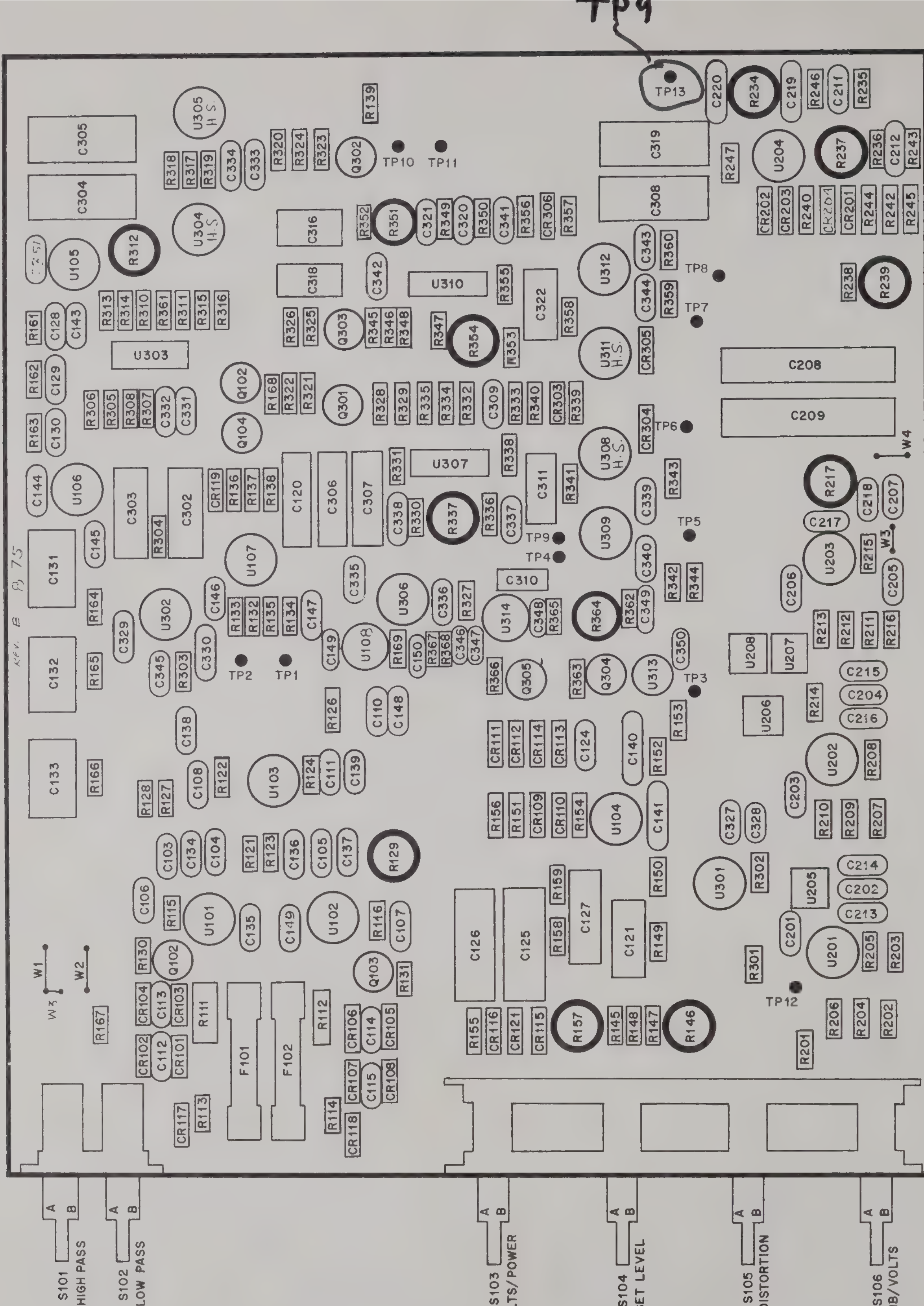


FIG. 4-1

SOUND TECHNOLOGY 1400 DELL AVENUE CAMPBELL, CALIFORNIA 95008
ANALYZER BOARD 8-75

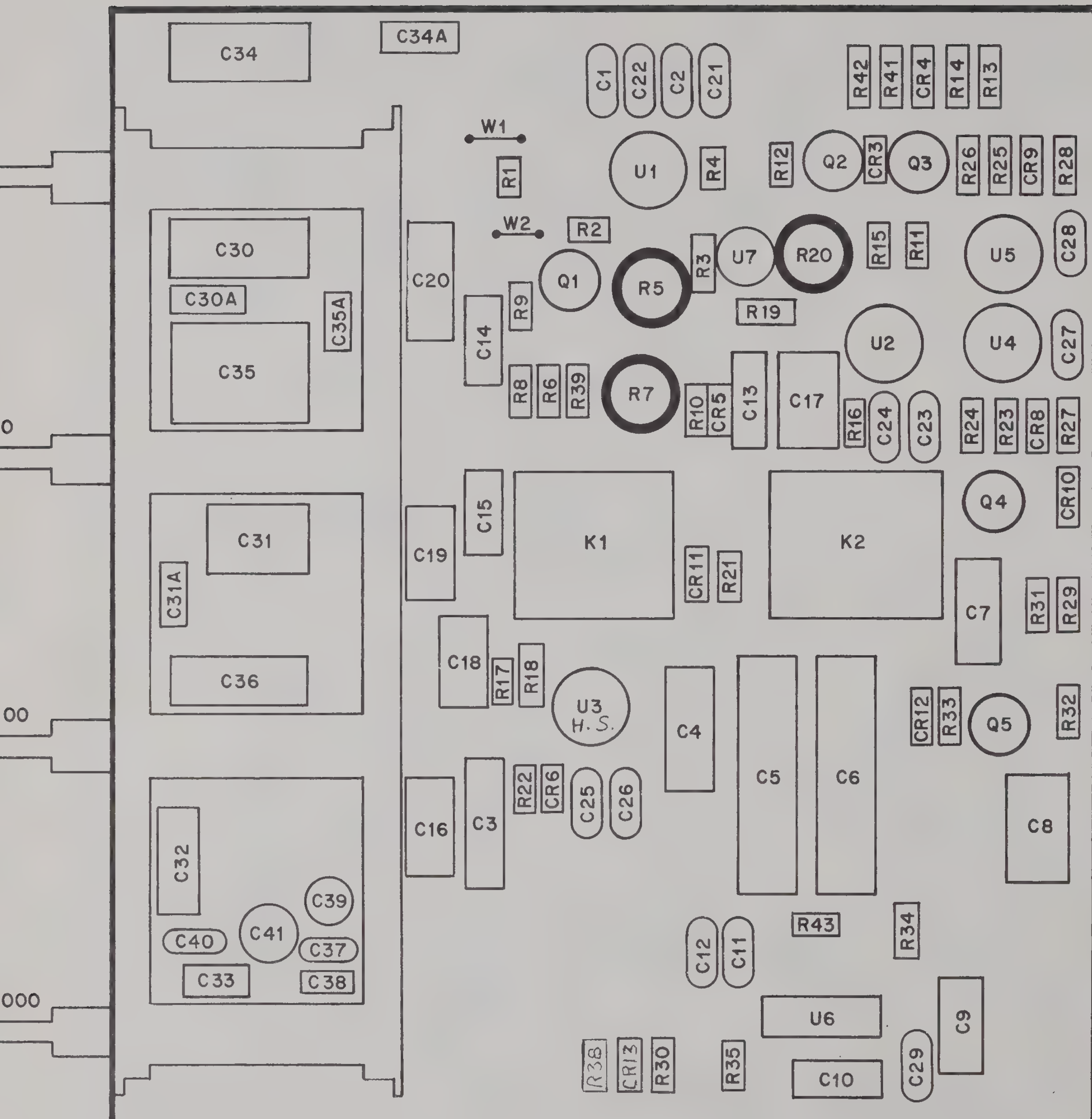
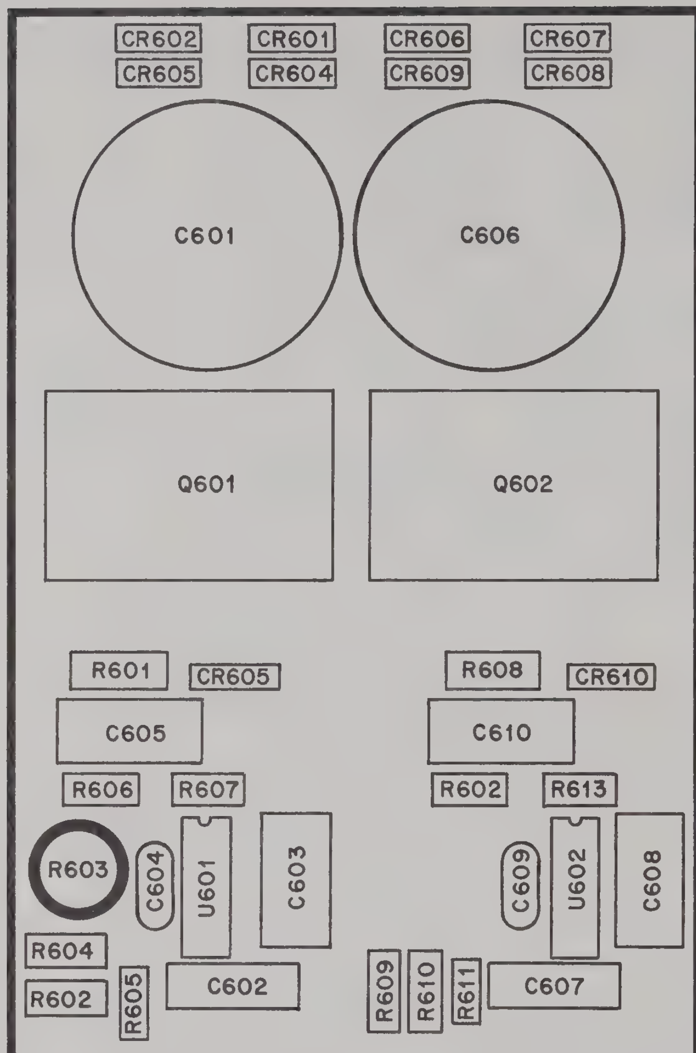


FIG. 4-3

SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008

OSCILLATOR BOARD

8-75



SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008

POWER SUPPLY BOARD

12-11-74

FIG. 4-6

SECTION V - SPARE PARTS

5-1. INTRODUCTION

This section contains information for ordering replacement parts, and provides the following details:

a. The Sound Technology part number.

b. Circuit diagram reference designator.

c. General description of part.

d. Total quantities used.

5-2. ORDERING INFORMATION

When ordering replacement parts, each part must be identified by a Sound Technology part number. To order a part include the following information:

a. Instrument model number.

b. Instrument serial number.

c. Description of part.

d. Function and location of part.

Address your order or inquiry to:

Sound Technology
1400 Dell Avenue
Campbell, California 95008

(408) 378-6540

5-3. PARTS LIST

1700A DISTORTION ANALYZER

PURCHASED PARTS

PART NO	DESCRIPTION	QTY
0300-0000	DIODE-LED RED CR7, 120, 301, 302	4.0
1400-0002	RES-VAR 2.5K 10% 2W LOG CARB R44	1.0
1400-0009	RES-VAR 2K 10% 2W SPST SWITCH R125	1.0
2020-0004	CAP-FXD 1UF 10% 100V TUBULAR C3	1.0
2020-0005	CAP-FXD 1UF 10% 400V TUBULAR C101, 102	2.0
2040-0001	CAP-FXD 0.01UF 2KV CERAMIC C1, 2	2.0
3000-0001	SWITCH-TOGGLE S3	1.0
3005-0000	SWITCH-SLIDE DPDT S6	2.0
3005-0001	SWITCH-SLIDE, LINE SELECT S5	1.0
3100-0000	CONNECTOR-BNC JACK, SHORT	1.0
3100-0001	CONNECTOR-BNC JACK, LONG	2.0
3110-0000	CONNECTOR-AC RECEPTACLE	1.0
3110-0001	CONNECTOR-BINDING POST, BROWN	4.0
3200-0002	TRANSFORMER-POWER 1700A T1	1.0
3200-0003	END CAP, LARGE-XFMR 1400/1700	1.0
3320-0000	METER-1MA, VRMS, PWR, DB M1	1.0
3440-0000	LAMP-NEON, AMBER DS1	1.0
3445-0001	CONNECTOR-LAMP	1.0
3445-0002	RETAINING CLIP-LAMP	1.0
3480-0002	FUSE-1 AMP, 3AG F1-3	3.0
3485-0000	FUSE HOLDER, 3AG	1.0
3485-0003	FUSE HOLDER-DOUBLE, SCREW MOUNT	1.0
7000-4000	WIRE-INS, BLK, 22 AWG, UL1007	3.6
7000-4001	WIRE-INS, BRN, 22 AWG, UL1007	5.0
7000-4002	WIRE-INS, RED, 22 AWG, UL1007	1.6
7000-4003	WIRE-INS, ORN, 22 AWG, UL1007	2.5
7000-4004	WIRE-INS, YEL, 22 AWG, UL1007	1.5
7000-4005	WIRE-INS, GRN, 22 AWG, UL1007	3.0
7000-4006	WIRE-INS, BLU, 22 AWG, UL1007	2.0
7000-4007	WIRE-INS, VIO, 22 AWG, UL1007	2.0
7000-4008	WIRE-INS, GRA, 22 AWG, UL1007	3.5
7000-4009	WIRE-INS, WHT, 22 AWG, UL1007	1.5
7000-4011	WIRE-INS, WHT/BRN, 22AWG, UL1007	3.0
7000-4012	WIRE-INS, WHT/RED, 22AWG, UL1007	1.5
7000-4014	WIRE-INS, WHT/YEL, 22AWG, UL1007	0.5
7004-0104	WIRE-TWSTD PR, BRN & YEL, 22 AWG	3.0
7004-0305	WIRE-TWSTD PR, ORN & GRN, 22 AWG	2.5
7005-0000	WIRE-BUSS 20 AWG	3.0
7050-0000	CABLE-1 COND. SHIELDED, WHT	6.0
7050-0003	CABLE-2 COND. SHLD. WHT, BLK/WHT	3.5
7100-0000	CABLE ASSY-LINE CORD	1.0
7600-0000	CARTON/FOAM 1700A	1.0
7700-0000	ALUM-VINYL CLAD 0.061 THK	4.5
7710-0001	BAR-.16 X .187 X 16.71 LG, ALUM	2.0
7777-0001	OPERATION-CUT BEZEL MATL 1700A	2.0
7777-0003	OPERATION-CUT SIDE BRACE 1700A	2.0
7777-0005	OPERATION-PAINT/SS, 01700-1006	1.0
7777-0007	OPERATION-PAINT 01700-1017	1.0
7777-0008	OPERATION-PAINT/SS 01700-1021	1.0
7777-0009	OPERATION-PAINT/SS 01700-1022	1.0
7777-0024	OPERATION-LCKNG MATL 8540-0109	8.0
7780-0000	EXTRUSION-ALUM BEZEL	8.7
7780-0001	EXTRUSION-ALUM SIDE BRACE	2.0
7900-0001	MANUAL- 1700A	1.0
8000-0000	PUSHBUTTON-WHITE	40.0
8000-0001	KNOB-ROUND 0.7 DIA BEIGE	2.0
8000-0002	KNOB-SKIRTED BEIGE	2.0

PART NO	DESCRIPTION	QTY
8005-0000	BAIL-14 INCH	1.0
8005-0002	FEET-BAIL LEFT	1.0
8005-0003	FEET-BAIL RIGHT	1.0
8005-0004	FEET-RUBBER	2.0
8005-0005	HANDLE-10 INCH	2.0
8020-0000	BUSHING-NYLINER 1/4ID, 5/16OD	1.0
8020-0001	GROMMET-PLASTIC, 0.380D BLK	8.0
8030-0000	CLAMP-CABLE	10.0
8030-0002	TIE-CABLE	14.0
8030-0004	MOUNT-CABLE TIE	1.0
8040-0001	CLAMP-COMPONENT, 3/4" DIA	2.0
8050-0000	LABEL-SERIAL TAG	1.0
8520-0004	SCREW 4-40 X 1/4 POZI PAN HD	16.0
8520-0006	SCREW 4-40 X 3/8 POZI PAN HD	4.0
8520-0104	SCREW 4-40 X 1/4, 82 FLAT HD	6.0
8520-0116	SCREW 4-40 X 1", 82 FLAT HD	4.0
8522-0001	LOCKWASHER-EXT #4	38.0
8526-0000	WASHER-SHOULDER, #4X3/8LG, NYLON	4.0
8528-0001	NUT-HEX 4-40 X 1/4	18.0
8540-0004	SCREW 6-32 X 1/4 POZI PAN HD	18.0
8540-0006	SCREW 6-32 X 3/8 POZI PAN HD	7.0
8540-0008	SCREW 6-32 X 1/2 POZI PAN HD	6.0
8540-0024	SCREW 6-32 X 1 1/2 POZI PAN HD	4.0
8540-0108	SCREW 6-32 X 1/2, 82 FLAT HD	7.0
8540-0109	SCREW 6-32X1/2, FLAT HD, LOCKING	8.0
8540-0112	SCREW 6-32 X 3/4, 82 FLAT HD	2.0
8540-0206	SCREW 6-32 X 3/8, 100 FLAT HD	16.0
8540-0208	SCREW 6-32 X 1/2, 100 FLAT HD	8.0
8540-0406	SCREW 6-32 X 3/8 HEX HD	1.0
8542-0001	LOCKWASHER-EXT #6	39.0
8544-0001	FLAT WASHER #6	4.0
8546-0000	WASHER-SHOULDER, #6 FIBER	12.0
8548-0001	NUT-HEX 6-32 X 5/16	16.0
8556-0001	WASHER-FLAT, #8 NYLON	12.0
8566-0000	WASHER-SHOULDER, #10 NYLON	12.0
8582-0001	LOCKWASHER-INT 5/16	4.0
8592-0001	LOCKWASHER-INT, 3/8	2.0
8596-0000	WASHER-SHOULDER, 3/8ID, NYLON	4.0
8610-0000	CLIP NUT- 6-32	24.0
8640-0001	DRIVE SCREW-#0 X 3/16, U TYPE	6.0
8650-0004	LUG, SOLDER-#4 INT LOCK	2.0
8650-0006	LUG, SOLDER-#6 INT LOCK	1.0
8650-0015	LUG-SOLDER, 5/16	1.0
8650-0016	LUG, SOLDER-3/8	2.0
8700-0000	SPACER-#6 X 3/8LG 1/4OD, BRS	2.0
8700-0001	SPACER-#8 X 5/8LG 1/4OD, PLAST	4.0
8722-0001	TERMINAL-INSULATED, 6-32 THD	1.0
8725-0000	TERMINAL STRIP-3 LUG	1.0
01700-1001	SUBPANEL-FRONT 1700A	1.0
01700-1002	PANEL REAR 1700A	1.0
01700-1003	SIDE BRACE-11 IN. 1700A	2.0
01700-1004	SHIELD-POWER SWITCH	1.0
01700-1005	SUBSHIELD-POWER SWITCH	1.0
01700-1006	TRIM PLATE-RIGHT, WITH OSC	1.0
01700-1008	BRACKET-METER	1.0
01700-1009	DECK OSCILLATOR 1700A	1.0
01700-1010	DECK ANALYZER 1700A	1.0
01700-1011	BRACKET-ROTARY SWITCH, REAR	1.0
01700-1012	DIVIDER 1700A	1.0
01700-1013	BRACKET-ROTARY SWITCH, FRONT	1.0
01700-1015	BRACKET-OSC PB SWITCHES	1.0
01700-1016	BRACKET-PUSHBUTTON SWITCH	2.0
01700-1017	TRIM PLATE-LEFT	1.0
01700-1021	FRONT PANEL-LOWER 1700A	1.0
01700-1022	FRONT PANEL-UPPER 1700A	1.0
01700-1025	SHIELD MULTIPLIER SWITCH 1700A	1.0
01700-2003	TRIM BAR 1700A	2.0
09990-1001	BEZEL- 17 X 8 3/4 H	2.0
09990-1002	DUST COVER-BOT. 17 X 12 DP	1.0
09990-1003	DUST COVER-TOP, 17 X 12 DP	1.0
09990-1004	PLATE-HANDLE, 12 INCH DP	2.0

SUBASSEMBLY PARTS

PART NO	DESCRIPTION	QTY
01700-30002	ASSY-PC, OSC FREQ-MSD	1.0
01700-30003	ASSY-PC, OSCILLATOR	1.0
01700-30004	ASSY-PC, ANAL FREQ MSD	1.0
01700-30005	ASSY-PC, ANAL MULTIPLIER	1.0
01700-30006	ASSY-PC, ANALYZER	1.0
01700-30009	ASSY-PC, PWR SUP, SYSTEM, SINGLE	1.0
01700-30010	ASSY-PC, ANAL FREQ 2ND DIGIT	1.0
01700-30011	ASSY-PC, ANAL FREQ 3RD DIGIT	1.0
01700-30012	ASSY-PC, OSC FREQ 2ND DIGIT	1.0
01700-30013	ASSY-PC, OSC FREQ 3RD DIGIT	1.0
01700-30014	INPUT SWITCH ASSEMBLY 1700A	1.0
01700-30015	RATIO SWITCH ASSEMBLY 1700A	1.0

01700-30002 ASSY-PC, OSC FREQ-MSD

PART NO	DESCRIPTION	QTY
1005-1176	RES-FXD 1.76K 0.25% 1/8W MF R101, 110	2.0
1005-1198	RES-FXD 1.98K 0.25% 1/8W MF R109, 118	2.0
1005-1226	RES-FXD 2.26K 0.25% 1/8W MF R108, 117	2.0
1005-1264	RES-FXD 2.64K 0.25% 1/8W MF R107, 116	2.0
1005-1316	RES-FXD 3.16K 0.25% 1/8W MF R106, 115	2.0
1005-1397	RES-FXD 3.97K 0.25% 1/8W MF R105, 114	2.0
1005-1530	RES-FXD 5.30K 0.25% 1/8W MF R104, 113	2.0
1005-1787	RES-FXD 7.87K 0.25% 1/8W MF R103, 112	2.0
1005-2158	RES-FXD 15.8K 0.25% 1/8W MF R102, 111	2.0
3015-0003	SWITCH-PB, 10 STA-4P	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5002	PC BOARD-OSC FREQUENCY	1.0

01700-30003 ASSY-PC, OSCILLATOR

PART NO	DESCRIPTION	QTY
0000-0001	TRANS 2N3644 PNP SI Q2, 3, 5	3.0
0005-0000	TRANS 2N3053 NPN SI Q4	1.0
0025-0000	TRANS-FET VCR2N N-CHAN Q1	1.0
0100-0001	IC-OP AMP 741 U2-5	4.0
0100-0007	IC-OP AMP 2605 GRADE 2 RED U1	1.0
0110-0000	IC-TIMER 556 U6	1.0
0200-0000	DIODE-GEN 1N914A SI CR3-6, 8-13	10.0
0305-0002	PHOTOCELL-LED GRADE 2 RED U7	1.0
1005-2158	RES-FXD 15.8K 0.25% 1/8W MF R1, 2	2.0
1015-0100	RES-FXD 100 1% 1/8W MF R19	1.0
1015-0316	RES-FXD 316 1% 1/8W MF R25	1.0
1015-1100	RES-FXD 1K 1% 1/8W MF R23	1.0
1015-1232	RES-FXD 2.32K 1% 1/8W MF R6	1.0
1015-1392	RES-FXD 3.92K 1% 1/8W MF R3	1.0
1015-1422	RES-FXD 4.22K 1% 1/8W MF R15	1.0
1015-1464	RES-FXD 4.64K 1% 1/8W MF R13	1.0
1015-2100	RES-FXD 10K 1% 1/8W MF R14	1.0

PART NO	DESCRIPTION	QTY
1015-2110	RES-FXD 11K 1% 1/8W MF R24, 26	2.0
1015-2332	RES-FXD 33.2K 1% 1/8W MF R10	1.0
1015-2511	RES-FXD 51.1K 1% 1/8W MF R17	1.0
1015-4100	RES-FXD 1M 1% 1/8W MF R18	1.0
1100-0051	RES-FXD 51 5% 1/4W R8	1.0
1100-0100	RES-FXD 100 5% 1/4W R11, 12	2.0
1100-0560	RES-FXD 560 5% 1/4W R21	1.0
1100-1100	RES-FXD 1K 5% 1/4W R9, 38, 41	3.0
1100-1330	RES-FXD 3.3K 5% 1/4W R29, 30	2.0
1100-1680	RES-FXD 6.8K 5% 1/4W R31	1.0
1100-1910	RES-FXD 9.1K 5% 1/4W R42	1.0
1100-2100	RES-FXD 10K 5% 1/4W R16, 22, 43	4.0
1100-2120	RES-FXD 12K 5% 1/4W R27, 28	2.0
1100-2510	RES-FXD 51K 5% 1/4W R33	1.0
1100-3100	RES-FXD 100K 5% 1/4W R32	1.0
1100-3150	RES-FXD 150K 5% 1/4W R39	1.0
1100-3390	RES-FXD 390K 5% 1/4W R34	1.0
1100-3820	RES-FXD 820K 5% 1/4W R35	1.0
1410-0002	RES-VAR 500 TRIMPOT CERMET R5	1.0
1410-0004	RES-VAR 5K TRIMPOT CERMET R20	1.0
1410-0006	RES-VAR 1M TRIMPOT CERMET R7	1.0
2000-0005	CAP-FXD 5PF 10% 500V MICA C1	1.0
2000-0022	CAP-FXD 22PF 5% 500V MICA C40	1.0
2000-0033	CAP-FXD 33PF 5% 500V MICA C37	1.0
2000-0056	CAP-FXD 56PF 5% 500V MICA C2	1.0
2020-0000	CAP-FXD 0.01UF 10% 100V MYLAR C7, 13	2.0
2020-0003	CAP-FXD 0.1UF 10% 100V MYLAR C16, 17	2.0
2025-0000	CAP-FXD 0.001UF 1% 33V PLYSTR C33	1.0
2025-0003	CAP-FXD 0.01UF 1% 33V PLYSTR C32	1.0
2025-0006	CAP-FXD 0.1UF 1% 33V PLYSTR C31, 35	2.0
2025-0009	CAP-FXD 1.007UF 1% 100V FILM C30, 34	2.0
2025-0016	CAP-FXD .0068UF 2.5% 63V PYSTR C30A, 34A	2.0
2025-0018	CAP-FXD 0.0099UF 1% 63V PLYSTR C36	1.0
2025-0019	CAP-FXD 680PF 2.5% 63V PLYSTR C31A, 35A	2.0
2025-0023	CAP-FXD 820PF 1% 63V PLYSTR C38	1.0
2040-0000	CAP-FXD 0.01UF 100V CERAMIC C11, 12, 21-29	10.0
2100-0000	CAP-FXD 4.7UF 10% 35V TANT C9, 10	2.0
2100-0001	CAP-FXD 1UF 25V ELECT AL C8, 14, 15, 18	3.0
2100-0003	CAP-FXD 10UF 25V ELECT AL C3, 19	2.0

PART NO	DESCRIPTION	QTY
2100-0004	CAP-FXD 35UF 25V ELECT AL C20	1.0
2100-0005	CAP-FXD 50UF 25V ELECT AL C4	1.0
2100-0008	CAP-FXD 390UF 12V ELECT AL C5,6	2.0
2100-0016	CAP-FXD 1UF 35V ELECT TANT	1.0
2205-0004	CAP-VAR 7-35PF TRIMMER CERAMIC C39,41	2.0
3015-0002	SWITCH-PB, 4 STA(2 SPACE)-6P S7	1.0
3105-0000	SOCKET-IC 8 PIN ROUND	5.0
3105-0001	SOCKET-IC 14 PIN DIP	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
3400-0000	RELAY-2 FORM C K1,2	2.0
3600-0000	HEAT SINK-ROUND FINNED TO5	1.0
7200-0001	WIRE JUMPER-0.2 CTRS,PVC INSUL	2.0
8720-0000	TERMINAL-BIFURCATED,SWAGE-IN	6.0
01700-5003	PC BOARD-OSCILLATOR	1.0

01700-30004 ASSY-PC, ANAL FREQ MSD

PART NO	DESCRIPTION	QTY
1005-1176	RES-FXD 1.76K 0.25% 1/8W MF R19	1.0
1005-1198	RES-FXD 1.98K 0.25% 1/8W MF R27	1.0
1005-1226	RES-FXD 2.26K 0.25% 1/8W MF R26	1.0
1005-1264	RES-FXD 2.64K 0.25% 1/8W MF R25	1.0
1005-1316	RES-FXD 3.16K 0.25% 1/8W MF R24	1.0
1005-1397	RES-FXD 3.97K 0.25% 1/8W MF R23	1.0
1005-1530	RES-FXD 5.30K 0.25% 1/8W MF R22	1.0
1005-1787	RES-FXD 7.87K 0.25% 1/8W MF R21	1.0
1005-1887	RES-FXD 8.87K 0.25% 1/8W MF R1	1.0
1005-2100	RES-FXD 10K 0.25% 1/8W MF R9	1.0
1005-2114	RES-FXD 11.4K 0.25% 1/8W MF R8	1.0
1005-2133	RES-FXD 13.3K 0.25% 1/8W MF R7	1.0
1005-2158	RES-FXD 15.8K 0.25% 1/8W MF R20	1.0
1005-2160	RES-FXD 16.0K 0.25% 1/8W MF R6	1.0
1005-2200	RES-FXD 20K 0.25% 1/8W MF R5	1.0
1005-2267	RES-FXD 26.7K 0.25% 1/8W MF R4	1.0
1005-2397	RES-FXD 39.7K 0.25% 1/8W MF R3	1.0
1005-2796	RES-FXD 79.6K 0.25% 1/8W MF R2	1.0
1100-0680	RES-FXD 680 5% 1/4W R10	1.0
1100-0750	RES-FXD 750 5% 1/4W R18	1.0
1100-0910	RES-FXD 910 5% 1/4W R17	1.0
1100-1120	RES-FXD 1.2K 5% 1/4W R16	1.0
1100-1150	RES-FXD 1.5K 5% 1/4W R15	1.0
1100-1200	RES-FXD 2K 5% 1/4W R14	1.0
1100-1270	RES-FXD 2.7K 5% 1/4W R13	1.0
1100-1470	RES-FXD 4.7K 5% 1/4W R12	1.0

PART NO	DESCRIPTION	QTY
1100-2100	RES-FXD 10K 5% 1/4W R11	1.0
3015-0004	SWITCH-PB, 10 STA-6P S9	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5004	PC BOARD-ANALYZER FREQUENCY	1.0

01700-30005 ASSY-PC, ANAL MULTIPLIER

PART NO	DESCRIPTION	QTY
2025-0001	CAP-FXD 0.002UF 1% 33V PLYSTR C3	1.0
2025-0002	CAP-FXD 0.0082UF 1% 33V PLYSTR C8	1.0
2025-0004	CAP-FXD 0.02UF 1% 33V PLYSTR C4	1.0
2025-0005	CAP-FXD 0.082UF 1% 33V PLYSTR C9	1.0
2025-0007	CAP-FXD 0.2UF 1% 100V FILM C5	1.0
2025-0008	CAP-FXD 0.82UF 1% 100V FILM C10	1.0
2025-0020	CAP-FXD 200PF 1% 63V PLYSTR C2	1.0
2025-0021	CAP-FXD 220PF 1% 63V PLYSTR C6	1.0
2025-0022	CAP-FXD 560PF 1% 63V PLYSTR C7	1.0
2205-0000	CAP-VAR 4.5-20PF TRIMMER CER C1	1.0
3015-0002	SWITCH-PB, 4 STA(2 SPACE)-6P S8	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5005	PC BOARD-MULTIPLIER	1.0

01700-30006 ASSY-PC, ANALYZER

PART NO	DESCRIPTION	QTY
0000-0001	TRANS 2N3644 PNP SI Q301,303,305	3.0
0005-0000	TRANS 2N3053 NPN SI Q102,302,304	3.0
0005-0002	TRANS 2N4996 NPN SI Q104	1.0
0020-0000	TRANS-FET MEM511C MOS P-CHAN Q102,103	2.0
0100-0000	IC-COMPARATOR 710 U107,302,306	3.0
0100-0001	IC-OP AMP 741 U106,304,305,308,309,311-314	8.0
0100-0002	IC-BAL MOD/DEMOD 1496 U303,307,310	3.0
0100-0003	IC-OP AMP 2625 U104,204	2.0
0100-0006	IC-OP AMP 2605 GRADE 1 BROWN U103	1.0
0100-0008	IC-OP AMP 2605 GRADE 3 ORANGE U101,102	2.0
0100-0009	IC-OP AMP 2605 GRADE 4 YELLOW U201,202	2.0
0100-0010	IC-OP AMP 2605 GRADE 5 GREEN U203,301	2.0
0100-0014	IC-OP AMP 2605 GRADE 6 BLUE U108	1.0
0100-0016	OP-AMP 301C U105	1.0
0200-0000	DIODE-GEN 1N914A SI CR101-108,109-116,119,121,201-206,303,306	24.0
0205-0000	DIODE-ZENER 1N755 7.5V CR117,118	2.0
0205-0001	DIODE-ZENER 1N963A 12V CR304,305	2.0
0305-0001	PHOTOCELL-LED GRADE 1 BROWN U205	1.0

PART NO	DESCRIPTION	QTY
0305-0004	PHOTOCELL-LED GRADE 4 YELLOW U206	1.0
0305-0006	PHOTOCELL-LED GRADE 6 BLUE U207, 208	2.0
1005-1422	RES-FXD 4.22K 0.25% 1/8W MF R115, 116	2.0
1005-2100	RES-FXD 10K 0.25% 1/8W MF R121-124	4.0
1005-2158	RES-FXD 15.8K 0.25% 1/8W MF R209	1.0
1005-2796	RES-FXD 79.6K 0.25% 1/8W MF R206	1.0
1015-0010	RES-FXD 10 1% 1/8W MF R158, 159	2.0
1015-0021	RES-FXD 21.5 1% 1/8W MF R147, 236, 238	3.0
1015-0056	RES-FXD 56.2 1% 1/8W MF R240	1.0
1015-0090	RES-FXD 90.9 1% 1/8W MF R148	1.0
1015-0316	RES-FXD 316 1% 1/8W MF R362	1.0
1015-0402	RES-FXD 402 1% 1/8W MF R323	1.0
1015-1100	RES-FXD 1K 1% 1/8W MF R126, 128, 201, 325, 332, 349	6.0
1015-1121	RES-FXD 1.21K 1% 1/8W MF R202, 326	2.0
1015-1200	RES-FXD 2K 1% 1/8W MF R235, 324	2.0
1015-1280	RES-FXD 2.8K 1% 1/8W MF R135, 165	2.0
1015-1392	RES-FXD 3.92K 1% 1/8W MF R311, 313, 336, 338, 353, 355	6.0
1015-1464	RES-FXD 4.64K 1% 1/8W MF R132	1.0
1015-1715	RES-FXD 7.15K 1% 1/8W MF R166, 314, 335, 352	4.0
1015-1750	RES-FXD 7.5K 1% 1/8W MF R133, 161-163	4.0
1015-1909	RES-FXD 9.09K 1% 1/8W MF R127, 212	2.0
1015-2100	RES-FXD 10K 1% 1/8W MF R145, 204, 205, 207, 208, 216, 342	7.0
1015-2110	RES-FXD 11K 1% 1/8W MF R134	1.0
1015-2475	RES-FXD 47.5K 1% 1/8W MF R215	1.0
1015-2499	RES-FXD 49.9K 1% 1/8W MF R164	1.0
1100-0010	RES-FXD 10 5% 1/4W R343, 368	2.0
1100-0022	RES-FXD 22 5% 1/4W R156	1.0
1100-0100	RES-FXD 100 5% 1/4W R150, 152, 153, 203, 303, 304, 327	7.0
1100-0180	RES-FXD 180 5% 1/4W R155, 365	2.0
1100-0270	RES-FXD 270 5% 1/4W R318	1.0
1100-0330	RES-FXD 330 5% 1/4W R246, 247, 320,	3.0
1100-0510	RES-FXD 510 5% 1/4W R139, 366	2.0
1100-1100	RES-FXD 1K 5% 1/4W R136, 151, 167, 243, 245, 310, 316, 344, 360	9.0
1100-1150	RES-FXD 1.5K 5% 1/4W R214, 333, 334	3.0
1100-1200	RES-FXD 2K 5% 1/4W R339, 357, 361	3.0
1100-1220	RES-FXD 2.2K 5% 1/4W R211, 305, 306, 328, 329, 345, 346, 359	8.0
1100-1270	RES-FXD 2.7K 5% 1/4W R322	1.0
1100-1330	RES-FXD 3.3K 5% 1/4W R321	1.0
1100-1390	RES-FXD 3.9K 5% 1/4W R315, 340, 356	3.0
1100-1510	RES-FXD 5.1K 5% 1/4W R113, 114, 137, 350	4.0
1100-2100	RES-FXD 10K 5% 1/4W R168, 307, 308, 317, 319, 330, 331, 347, 348, 358, 363, 367 367	12.0
1100-2150	RES-FXD 15K 5% 1/4W R242, 244	2.0
1100-2180	RES-FXD 18K 5% 1/4W R213	1.0
1100-2270	RES-FXD 27K 5% 1/4W R341	1.0
1100-2330	RES-FXD 33K 5% 1/4W R210	1.0
1100-3100	RES-FXD 100K 5% 1/4W R130, 131, 138, 301, 302	5.0
1100-4100	RES-FXD 1M 5% 1/4W R149, 154, 169	3.0
1200-2000	RES-FXD 500 3W WW R111, 112	2.0
1410-0001	RES-VAR 100 TRIMPOT CERMET R157, 239, 312, 337, 359	5.0
1410-0003	RES-VAR 1K TRIMPOT CERMET R146, 237	2.0
1410-0005	RES-VAR 100K TRIMPOT CERMET R129, 217, 234	3.0
1410-0007	RES-VAR 20K TRIMPOT CERMET R351	1.0
1411-0000	RES-VAR 1K TRIMPOT WIREWOUND R364	1.0
2000-0010	CAP-FXD 10PF 5% 500V MICA C103, 106, 108, 111, 201, 205, 206, 309,	8.0
2000-0012	CAP-FXD 12PF 5% 500V MICA C351	1.0
2000-0022	CAP-FXD 22PF 5% 500V MICA C203	1.0
2000-0027	CAP-FXD 27PF 5% 500V MICA C149, 107	2.0
2000-0047	CAP-FXD 47PF 5% 500V MICA C320	1.0
2000-0051	CAP-FXD 51PF 5% 500V MICA C128	1.0
2000-0056	CAP-FXD 56PF 5% 500V MICA C104, 105, 110, 124, 148, 202, 204, 207, 212	9.0
2000-0082	CAP-FXD 82PF 5% 500V MICA C211	1.0
2000-0100	CAP-FXD 100PF 5% 500V MICA C345, 346	2.0
2000-0270	CAP-FXD 270PF 5% 500V MICA C112-115	4.0
2000-0360	CAP-FXD 360PF 5% 500V MICA C130	1.0
2000-0910	CAP-FXD 910PF 5% 500V MICA C129	1.0
2020-0001	CAP-FXD 0.022UF 10% 100V MYLAR C311, 322	2.0
2020-0003	CAP-FXD 0.1UF 10% 100V MYLAR C121	1.0
2025-0010	CAP-FXD .039UF 2.5% 33V PLYSTR C131-133	3.0
2040-0000	CAP-FXD 0.01UF 100V CERAMIC C134-139, 142-147, 213-220, 321, 327, 328, 331-334, 337-344	39.0
2040-0002	CAP-FXD 0.1UF 25V CERAMIC C140, 141, 219, 220, 325, 326, 329, 330	8.0
2100-0001	CAP-FXD 1UF 25V ELECT AL C310	1.0
2100-0004	CAP-FXD 35UF 25V ELECT AL C120, 127, 302, 303, 306, 307, 316, 318	8.0
2100-0006	CAP-FXD 100UF 25V ELECT AL C125, 126, 304, 305, 308, 319	6.0
2100-0007	CAP-FXD 200UF 25V ELECT AL C208, 209	2.0
3015-0000	SWITCH-PB, 2 STA-2P, P-P S101, 102	1.0
3015-0001	SWITCH-PB 4 STA(1 SPACE)-2P S103-106	1.0
3105-0000	SOCKET-IC 8 PIN ROUND	23.0
3105-0001	SOCKET-IC 14 PIN DIP	3.0

PART NO	DESCRIPTION	QTY
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	8.0
3480-0000	FUSE-1/8 AMP, 3AG	2.0
3485-0001	CLIP-FUSE, PC	4.0
3600-0000	HEAT SINK-ROUND FINNED TO5	4.0
7200-0000	WIRE JUMPER-0.4 CTRS,PVC INSUL	2.0
7200-0001	WIRE JUMPER-0.2 CTRS,PVC INSUL	2.0
8702-0000	STANDOFF- 4-40X3/4,1/4 HEX	2.0
8720-0000	TERMINAL-BIFURCATED,SWAGE-IN	6.0
01700-1024	SHIELD-BUFFER 1700A	1.0
01700-5006	PC BOARD-ANALYZER	1.0

01700-30009 ASSY-PC, PWR SUP

PART NO	DESCRIPTION	QTY
0005-0001	TRANS-POWER 2N3055 NPN SI Q601,602	2.0
0100-0012	IC-REGULATOR 723, DIP 14 PIN U1,2	2.0
0200-0001	DIODE-RECT 1N4003 SI CR601-610	10.0
1015-1422	RES-FXD 4.22K 1% 1/8W MF R604	1.0
1015-1464	RES-FXD 4.64K 1% 1/8W MF R602	1.0
1015-1715	RES-FXD 7.15K 1% 1/8W MF R610	1.0
1015-1787	RES-FXD 7.87K 1% 1/8W MF R609	1.0
1100-1150	RES-FXD 1.5K 5% 1/4W R606,612	2.0
1100-1220	RES-FXD 2.2K 5% 1/4W R605	1.0
1100-1390	RES-FXD 3.9K 5% 1/4W R611	1.0
1100-2150	RES-FXD 15K 5% 1/4W R607,613	2.0
1110-4000	RES-FXD 9.1 OHM, 5%, 1W R608	1.0
1200-1000	RES-FXD 5 2W WW R601	1.0
1410-0002	RES-VAR 500 TRIMPOT CERMET R603	1.0
2000-0100	CAP-FXD 100PF 5% 500V MICA R604,609	2.0
2020-0000	CAP-FXD 0.01UF 10% 100V MYLAR C602,607	2.0
2100-0004	CAP-FXD 35UF 25V ELECT AL C603,605,608,610	3.0
2100-0006	CAP-FXD 100UF 25V ELECT AL C610	1.0
2100-0009	CAP-FXD 1800-2500UF 40-50V EL C606	1.0
2100-0010	CAP-FXD 3000-4200UF 40-50V EL C601	1.0
3150-0005	INSULATOR- TO-3 TRANSISTOR	2.0
3150-0007	INSULATOR-TRANS, T0-3 NYLON	2.0
3600-0001	HEAT SINK-TO3	2.0
8540-0008	SCREW 6-32 X 1/2 POZI PAN HD	4.0
8542-0001	LOCKWASHER-EXT #6	8.0
8548-0001	NUT-HEX 6-32 X 5/16	4.0
8720-0000	TERMINAL-BIFURCATED,SWAGE-IN	4.0
01700-5007	PC BOARD-POWER SUPPLY	1.0

01700-30010 ASSY-PC, ANAL FREQ 2ND DIGIT

PART NO	DESCRIPTION	QTY
1005-2174	RES-FXD 17.4K 0.25% 1/8W MF R54	1.0
1005-2196	RES-FXD 19.6K 0.25% 1/8W MF R53	1.0
1005-2226	RES-FXD 22.6K 0.25% 1/8W MF R52	1.0
1005-2887	RES-FXD 88.7K 0.25% 1/8W MF R36	1.0
1005-3100	RES-FXD 100K 0.25% 1/8W MF R35	1.0
1005-3115	RES-FXD 115K 0.25%% 1/8W MF R34	1.0
1015-2261	RES-FXD 26.1K 1% 1/8W MF R51	1.0
1015-2316	RES-FXD 31.6K 1% 1/8W MF R50	1.0
1015-2392	RES-FXD 39.2K 1% 1/8W MF R49	1.0
1015-2523	RES-FXD 52.3K 1% 1/8W MF R48	1.0
1015-2787	RES-FXD 78.7K 1% 1/8W MF R47	1.0
1015-3133	RES-FXD 133K 1% 1/8W MF R33	1.0
1015-3158	RES-FXD 158K 1% 1/8W MF R32,46	2.0
1015-3200	RES-FXD 200K 1% 1/8W MF R31	1.0
1015-3267	RES-FXD 267K 1% 1/8W MF R30	1.0
1015-3402	RES-FXD 402K 1% 1/8W MF R29	1.0
1015-3806	RES-FXD 806K 1% 1/8W MF R28	1.0
1100-2100	RES-FXD 10K 5% 1/4W R45	1.0
1100-2120	RES-FXD 12K 5% 1/4W R44	1.0
1100-2150	RES-FXD 15K 5% 1/4W R43	1.0
1100-2160	RES-FXD 16K 5% 1/4W R42	1.0
1100-2180	RES-FXD 18K 5% 1/4W R41	1.0
1100-2220	RES-FXD 22K 5% 1/4W R40	1.0
1100-2330	RES-FXD 33K 5% 1/4W R39	1.0
1100-2510	RES-FXD 51K 5% 1/4W R38	1.0
1100-2820	RES-FXD 82K 5% 1/4W R37	1.0
3015-0004	SWITCH-PB, 10 STA-6P S10	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5004	PC BOARD-ANALYZER FREQUENCY	1.0

01700-30011 ASSY-PC, ANAL FREQ 3RD DIGIT

PART NO	DESCRIPTION	QTY
1015-3178	RES-FXD 178K 1% 1/8W MF R72	1.0
1015-3200	RES-FXD 200K 1% 1/8W MF R71	1.0
1015-3226	RES-FXD 226K 1% 1/8W MF R70	1.0
1015-3267	RES-FXD 267K 1% 1/8W MF R69	1.0
1015-3324	RES-FXD 324K 1% 1/8W MF R68	1.0
1015-3887	RES-FXD 887K 1% 1/8W MF R63	1.0
1015-4100	RES-FXD 1M 1% 1/8W MF R62	1.0
1100-3390	RES-FXD 390K 5% 1/4W R67	1.0
1100-3560	RES-FXD 560K 5% 1/4W R66	1.0
1100-3820	RES-FXD 820K 5% 1/4W R65	1.0
1100-4110	RES-FXD 1.1M 5% 1/4W R61	1.0
1100-4130	RES-FXD 1.3M 5% 1/4W R60	1.0
1100-4160	RES-FXD 1.6M 5% 1/4W R59,64	2.0

PART NO	DESCRIPTION	QTY
1100-4200	RES-FXD 2M 5% 1/4W R58	1.0
1100-4270	RES-FXD 2.7M 5% 1/5W R57	1.0
1100-4390	RES-FXD 3.9M 5% 1/4W R56	1.0
1100-4820	RES-FXD 8.2M 5% 1/4W R55	1.0
3015-0004	SWITCH-PB, 10 STA-6P S11	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5004	PC BOARD-ANALYZER FREQUENCY	1.0

01700-30012 ASSY-PC, OSC FREQ 2ND DIGIT

PART NO	DESCRIPTION	QTY
1005-2174	RES-FXD 17.4K 0.25% 1/8W MF R127,136	2.0
1005-2196	RES-FXD 19.6K 0.25% 1/8W MF R126,135	2.0
1005-2226	RES-FXD 22.6K 0.25% 1/8W MF R125,134	2.0
1015-2261	RES-FXD 26.1K 1% 1/8W MF R124,133	2.0
1015-2316	RES-FXD 31.6K 1% 1/8W MF R123,132	2.0
1015-2392	RES-FXD 39.2K 1% 1/8W MF R122,131	2.0
1015-2523	RES-FXD 52.3K 1% 1/8W MF R121,130	2.0
1015-2787	RES-FXD 78.7K 1% 1/8W MF R120,129	2.0
1015-3158	RES-FXD 158K 1% 1/8W MF R119,128	2.0
3015-0003	SWITCH-PB, 10 STA-4P S13	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5002	PC BOARD-OSC FREQUENCY	1.0

01700-30013 ASSY-PC, OSC FREQ 3RD DIGIT

PART NO	DESCRIPTION	QTY
1015-3178	RES-FXD 178K 1% 1/8W MF R145,154	2.0
1015-3200	RES-FXD 200K 1% 1/8W MF R144,153	2.0
1015-3226	RES-FXD 226K 1% 1/8W MF R143,152	2.0
1015-3267	RES-FXD 267K 1% 1/8W MF R142,151	2.0
1015-3324	RES-FXD 324K 1% 1/8W MF R141,150	2.0
1100-3390	RES-FXD 390K 5% 1/4W R140,149	2.0
1100-3560	RES-FXD 560K 5% 1/4W R139,148	2.0
1100-3820	RES-FXD 820K 5% 1/4W R138,147	2.0
1100-4160	RES-FXD 1.6M 5% 1/4W R137,146	2.0
3015-0003	SWITCH-PB, 10 STA-4P S14	1.0
3150-0002	SPACER-PUSHBUTTON SW, DOGBONE	4.0
01700-5002	PC BOARD-OSC FREQUENCY	1.0

01700-30014 INPUT SWITCH ASSEMBLY 1700A

PART NO	DESCRIPTION	QTY
1000-0001	RES-FXD 102 0.1% 1/8W R144	1.0
1000-0002	RES-FXD 953 0.1% 1/8W R118	1.0
1000-0003	RES-FXD 3.92K 0.1% 1/8W R120	1.0
1005-0221	RES-FXD 221 0.25% 1/8W MF R143	1.0
1005-0698	RES-FXD 698 0.25% 1/8W MF R142	1.0
1005-1102	RES-FXD 1.02K 0.25% 1/8W MF R105,110	2.0
1005-1221	RES-FXD 2.21K 0.25% 1/8W MF R104,109,141	3.0
1005-1698	RES-FXD 6.98K 0.25% 1/8W MF R103,108,142	3.0
1007-2221	RES-FXD 22.1K 0.25% 1/2W MF R102,107	2.0
1008-2698	RES-FXD 69.8K 0.25% 1W MF R101,106	2.0
1100-2560	RES-FXD 56K 5% 1/4W R117	1.0
1100-3910	RES-FXD 910K 5% 1/4W R119	1.0
2000-0005	CAP-FXD 5PF 10% 500V MICA C116,118	2.0
3010-0001	SWITCH-ROTARY, INPUT 1700A S1	1.0

01700-30015 RATIO SWITCH ASSEMBLY 1700A

PART NO	DESCRIPTION	QTY
1005-0475	RES-FXD 475 0.25% 1/8W MF R232	1.0
1005-0690	RES-FXD 690 0.25% 1/8W MF R226-231	6.0
1005-1102	RES-FXD 1.02K 0.25% 1/8W MF R219-225	7.0
1015-2681	RES-FXD 68.1K 1% 1/8W MF R233	1.0
1100-0360	RES-FXD 360 5% 1/4W R218	1.0
2100-0001	CAP-FXD 1UF 25V ELECT AL C312,323	2.0
2100-0003	CAP-FXD 10UF 25V ELECT AL C313,324	2.0
2100-0006	CAP-FXD 100UF 25V ELECT AL C314,315	2.0
2100-0017	CAP-FXD 33UF 15V ELECT LO LEAK C325	1.0
2100-0018	CAP-FXD 100UF 25V ELEC LO LEAK C326	1.0
3010-0000	SWITCH-ROTARY, RATIO 1700A S2	1.0

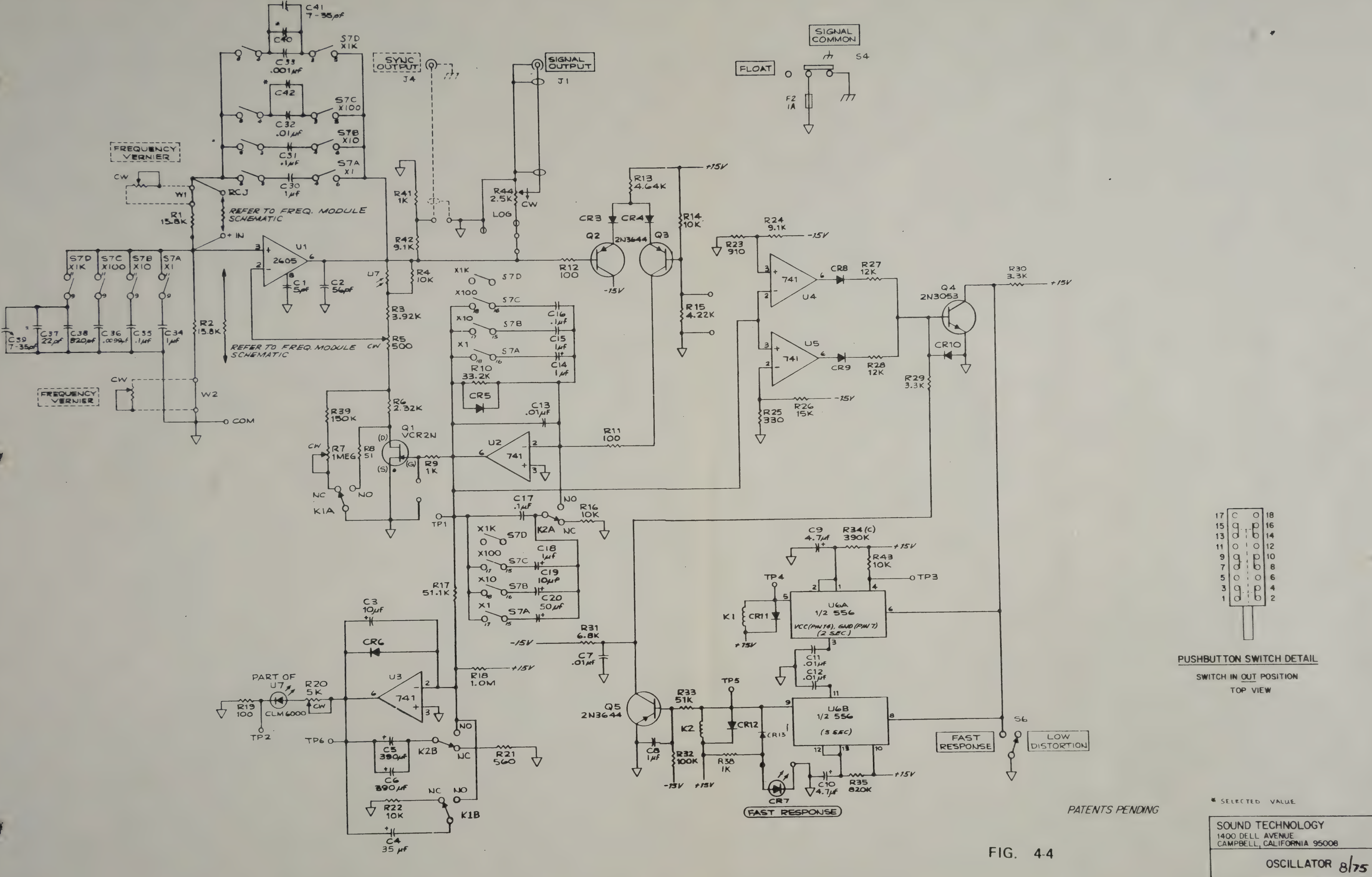
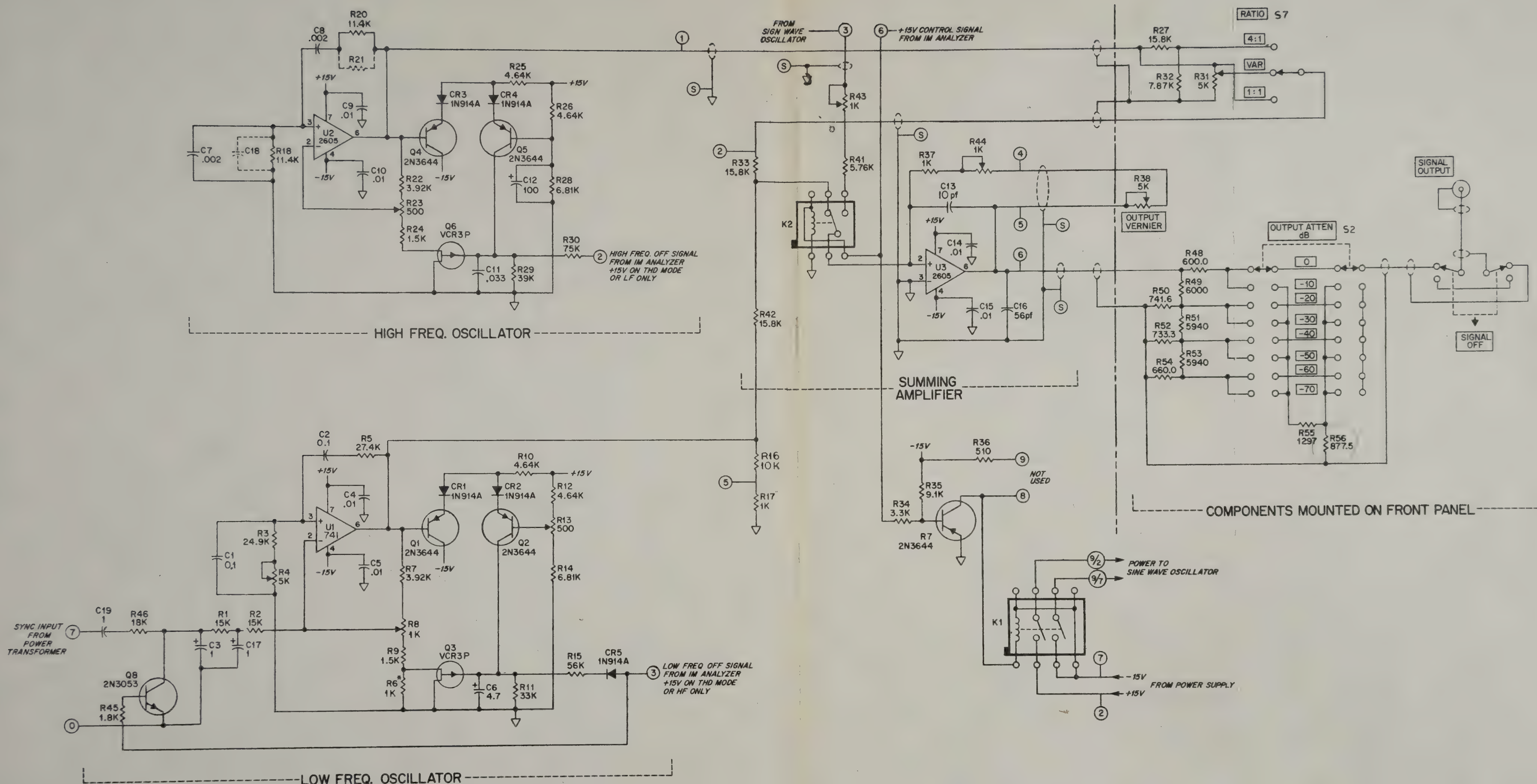

SYNC OUTPUT
J4
SIGNAL OUTPUT
J1
SIGNAL COMMON
FLOAT
S4
F2 1A
FREQUENCY VERNIER
REFER TO FREQ. MODULE SCHEMATIC
U1 2605
U2 741
U3 741
U4 741
U5 741
Q1 VCR2N
Q2 2N3644
Q3
Q4 2N3053
Q5 2N3644
U6A 1/2 556
VCC(PIN 14), GND (PIN 7) (2 SEC)
U6B 1/2 556 (5 SEC)
PART OF U7
CLM 6000
K1A
K1B
K2A
K2B
FAST RESPONSE
LOW DISTORTION
S6
PUSHBUTTON SWITCH DETAIL
SWITCH IN OUT POSITION
TOP VIEW
PATENTS PENDING
* SELECTED VALUE
SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
OSCILLATOR 8/75

FIG. 4-4

CP7



6-2

SOUND TECHNOLOGY
1400 DELL AVENUE, CAMPBELL, CALIFORNIA

IM GENERATOR BOARD

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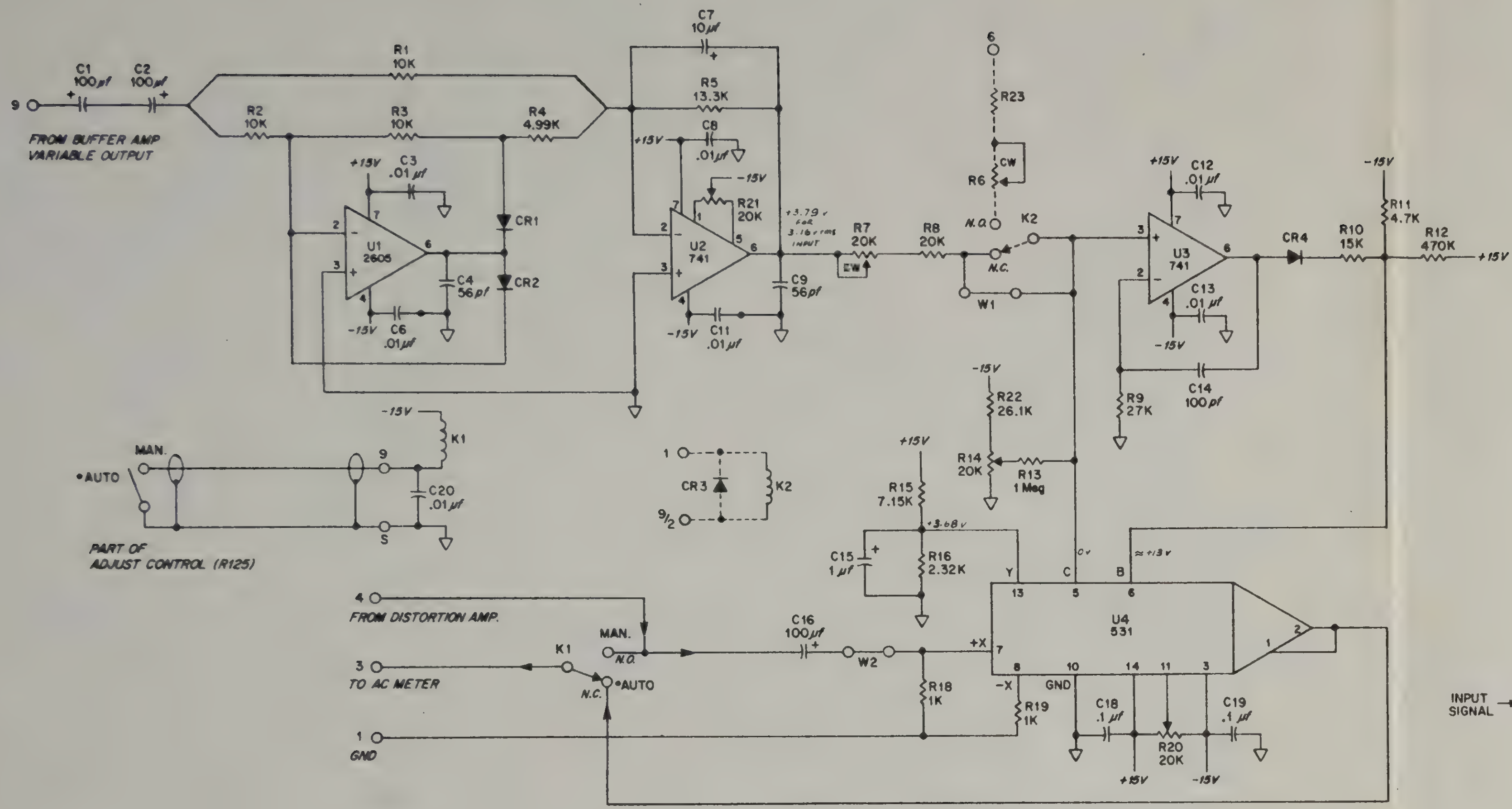
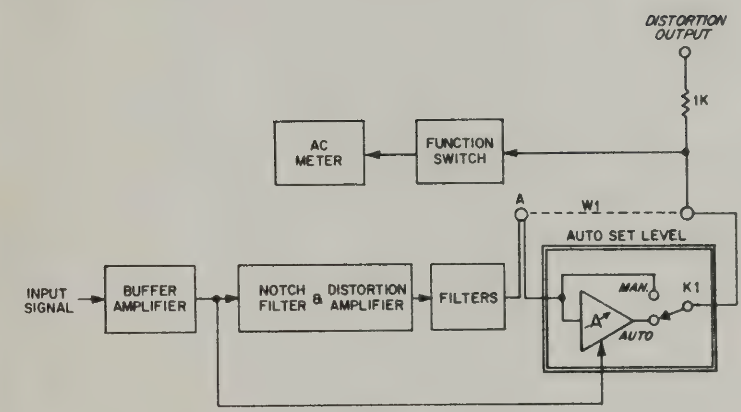
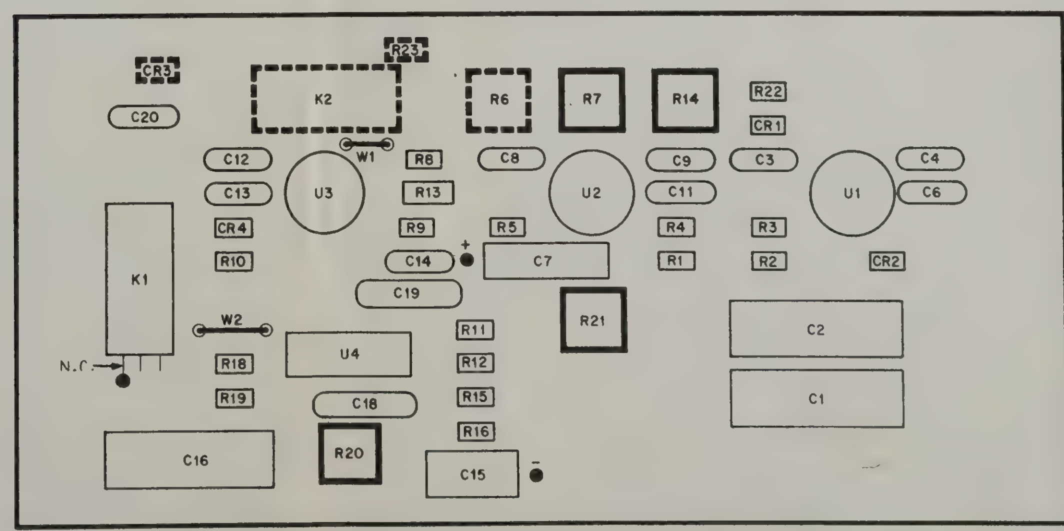


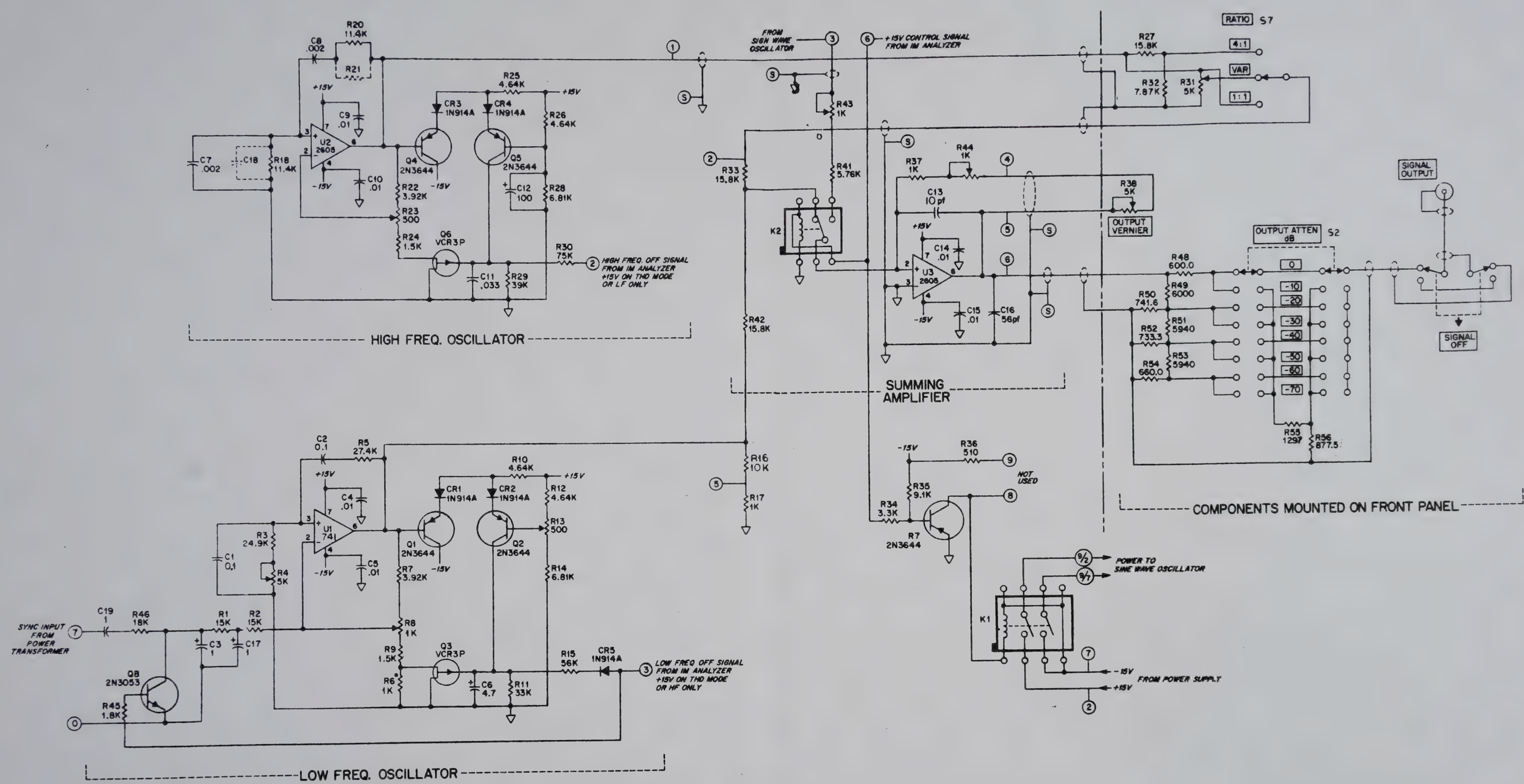




SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008

AUTO SET LEVEL OPTION

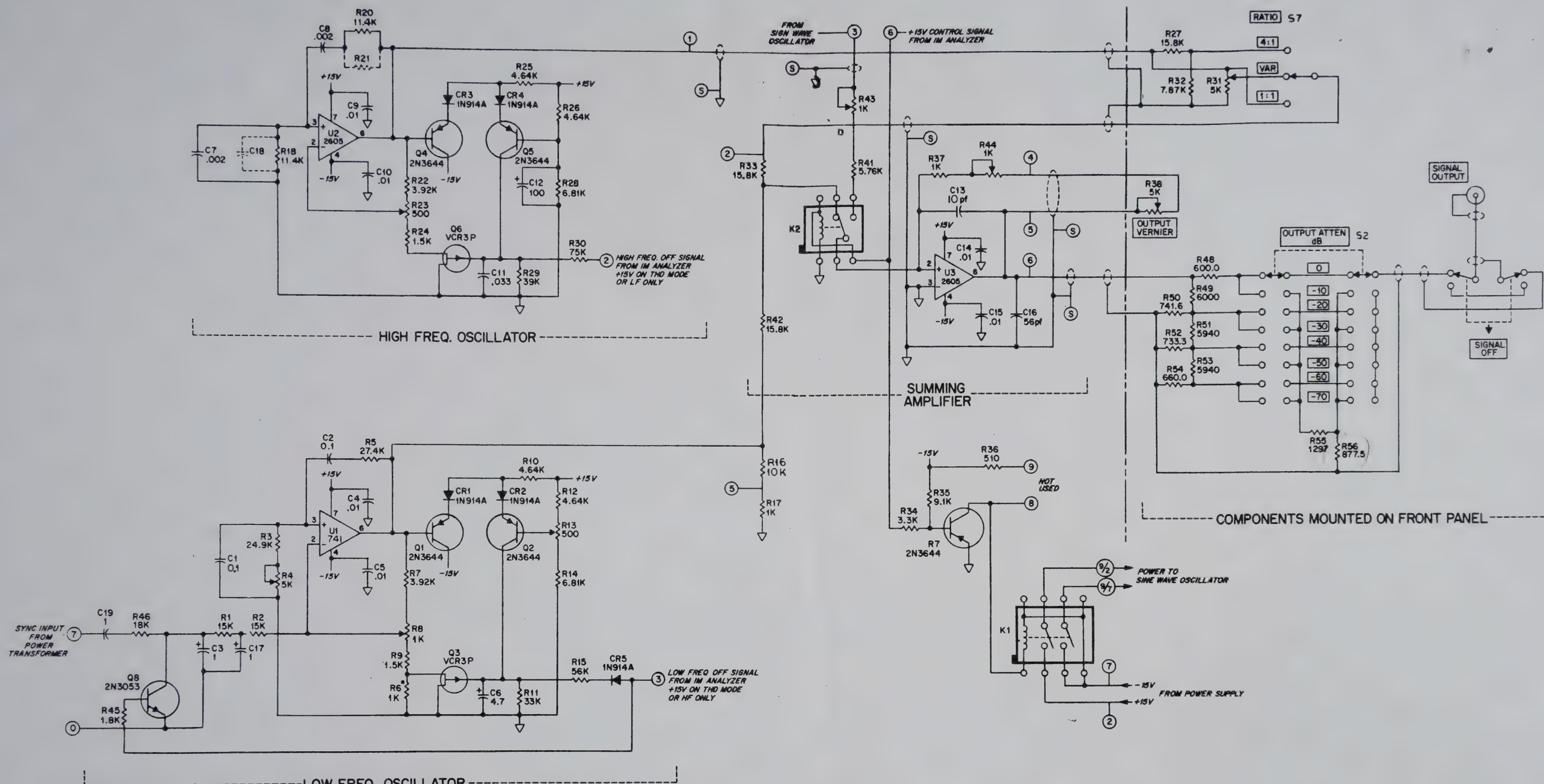
5-31-75



SOUND TECHNOLOGY
1400 DELL AVENUE, CAMPBELL, CALIFORNIA

IM GENERATOR BOARD

4/76

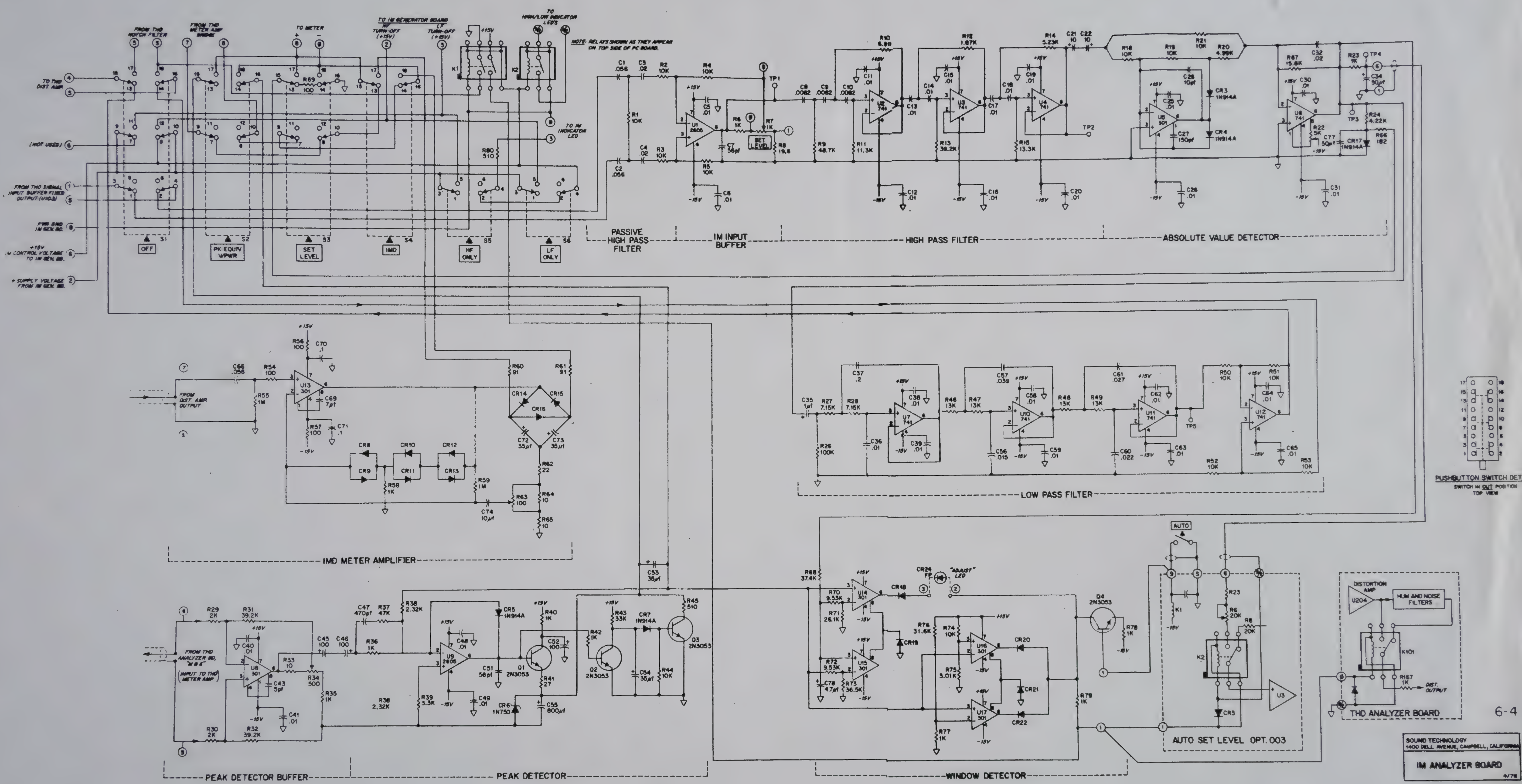


6-2

SOUND TECHNOLOGY
1400 DELL AVENUE, CAMPBELL, CALIFORNIA

IM GENERATOR BOARD

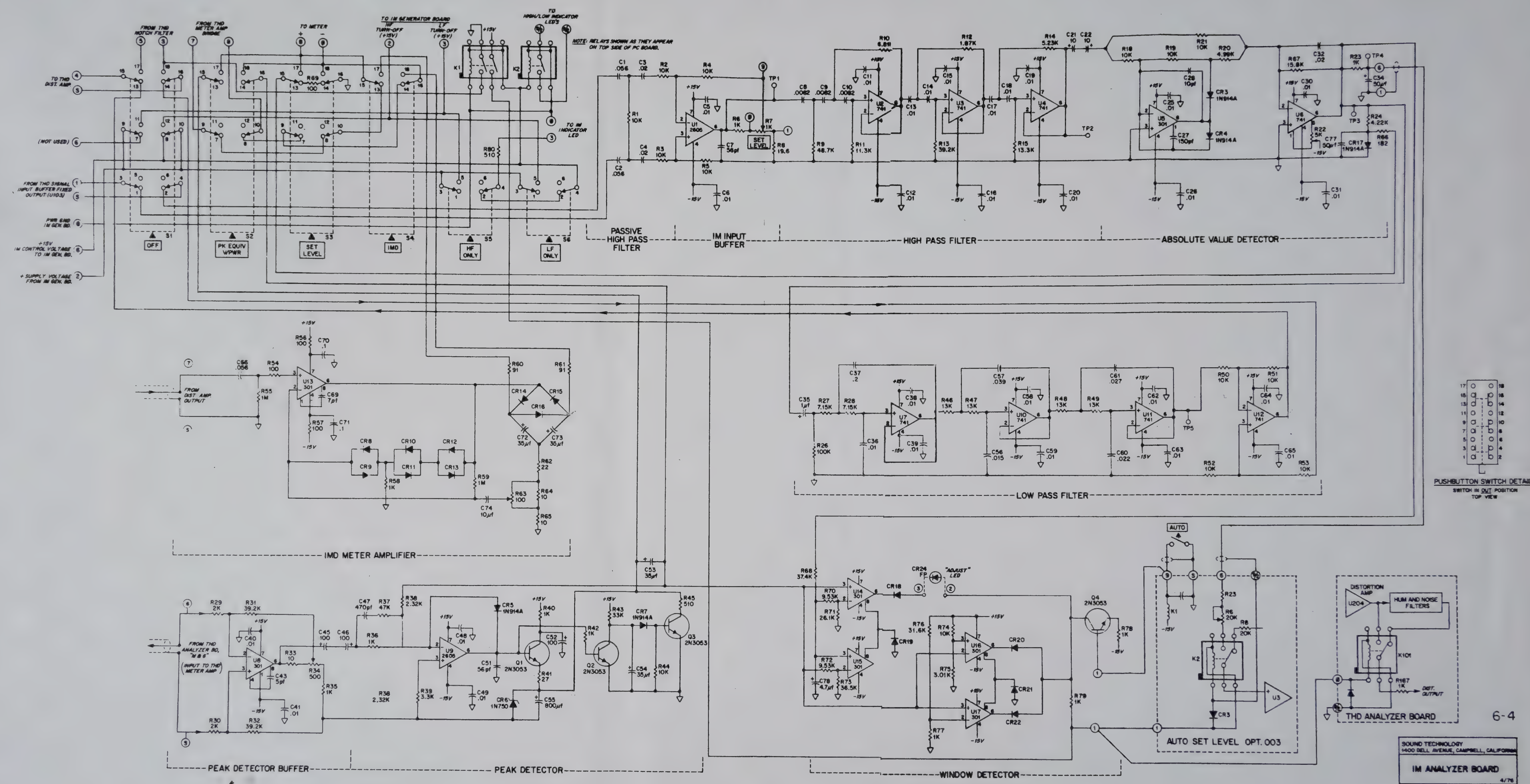
4/76



SOUND TECHNOLOGY
1400 DELL AVENUE, CAMPBELL, CALIFORNIA

IM ANALYZER BOARD

4/76



6-4

SOUND TECHNOLOGY
1400 DELL AVENUE, CAMPBELL, CALIFORNIA

IM ANALYZER BOARD

4/76

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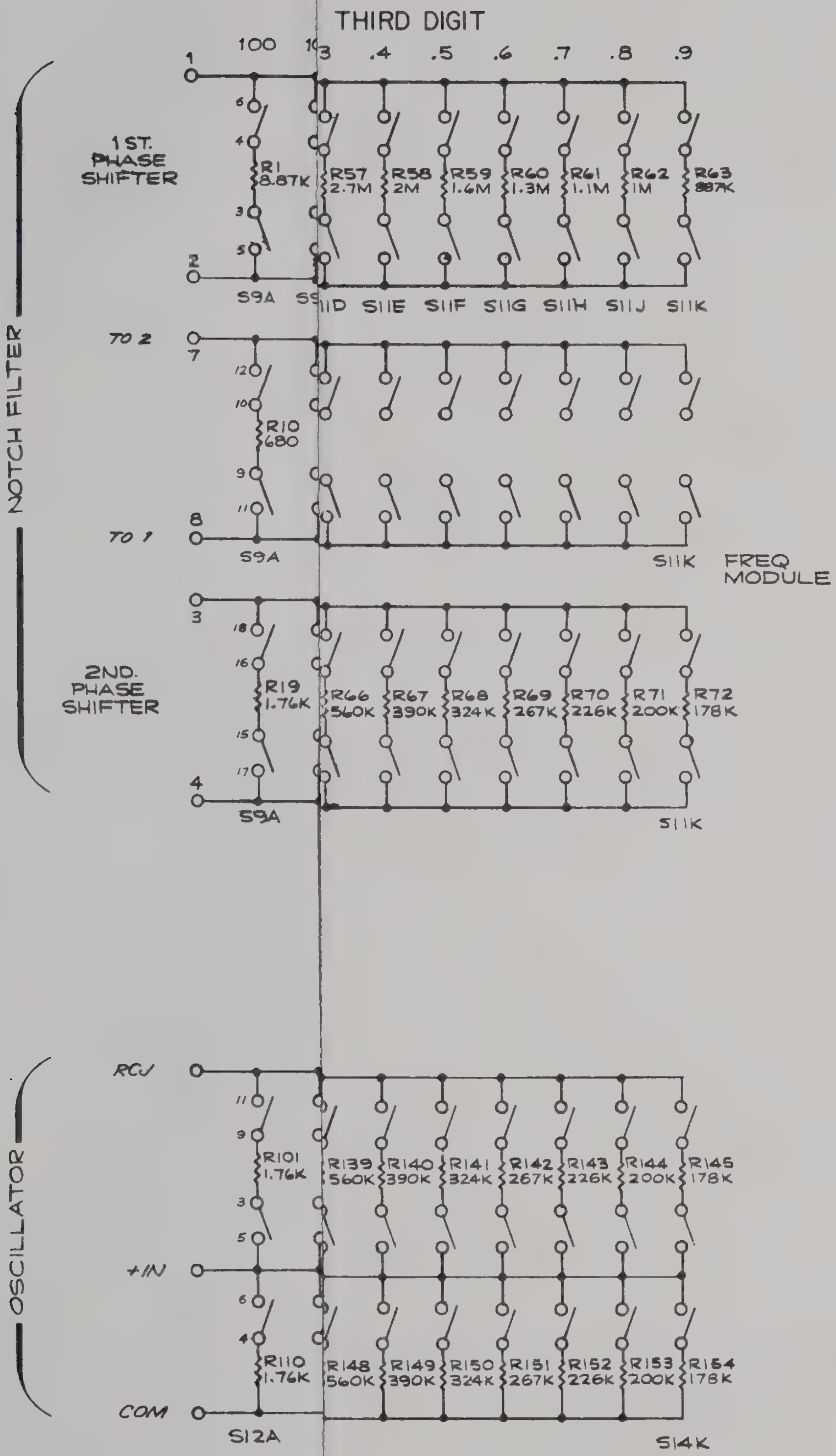
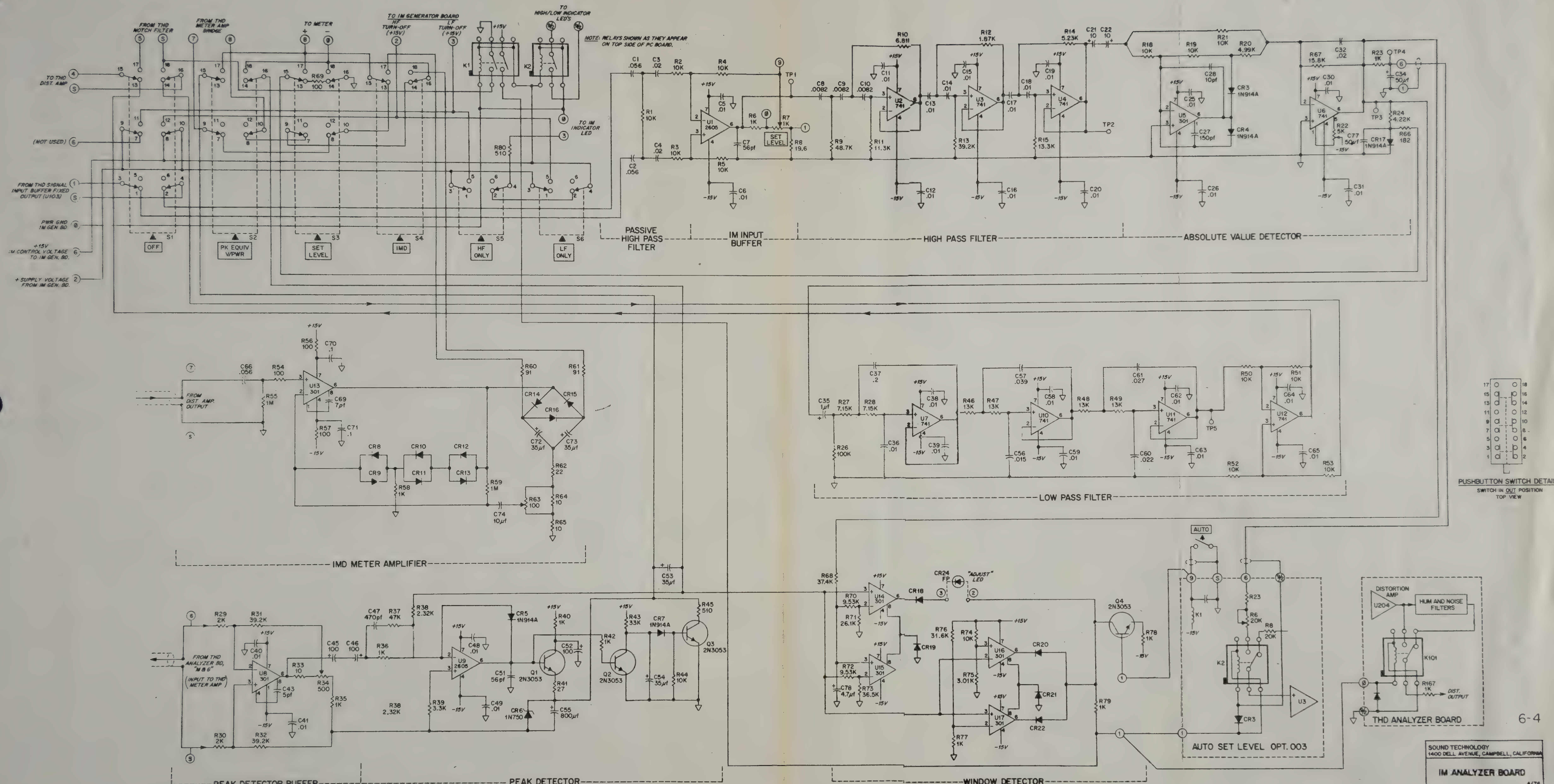


SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008

FREQUENCY MODULES

1-28-75

FIG. 4-5


NOTE: RELAYS SHOWN AS THEY APPEAR ON TOP SIDE OF PC BOARD.
PASSIVE HIGH PASS FILTER
IM INPUT BUFFER
HIGH PASS FILTER
ABSOLUTE VALUE DETECTOR
LOW PASS FILTER
IMD METER AMPLIFIER
PEAK DETECTOR BUFFER
PEAK DETECTOR
WINDOW DETECTOR
AUTO SET LEVEL OPT. 003
THD ANALYZER BOARD
PUSHBUTTON SWITCH DETAIL
SWITCH IN OUT POSITION TOP VIEW
OFF
PK EQUIV W/PWR
SET LEVEL
IMD
HF ONLY
LF ONLY
SOUND TECHNOLOGY 1400 DELL AVENUE, CAMPBELL, CALIFORNIA
IM ANALYZER BOARD
4/76

★ *Measure .002% distortion in less than 5 seconds.*

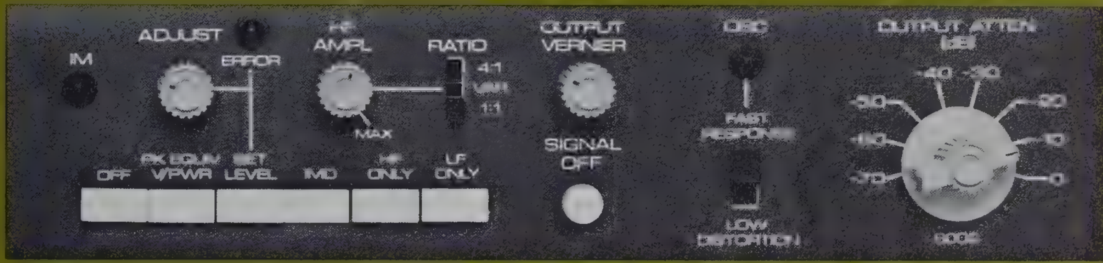
★ *Measure ac voltage with 2% accuracy.*

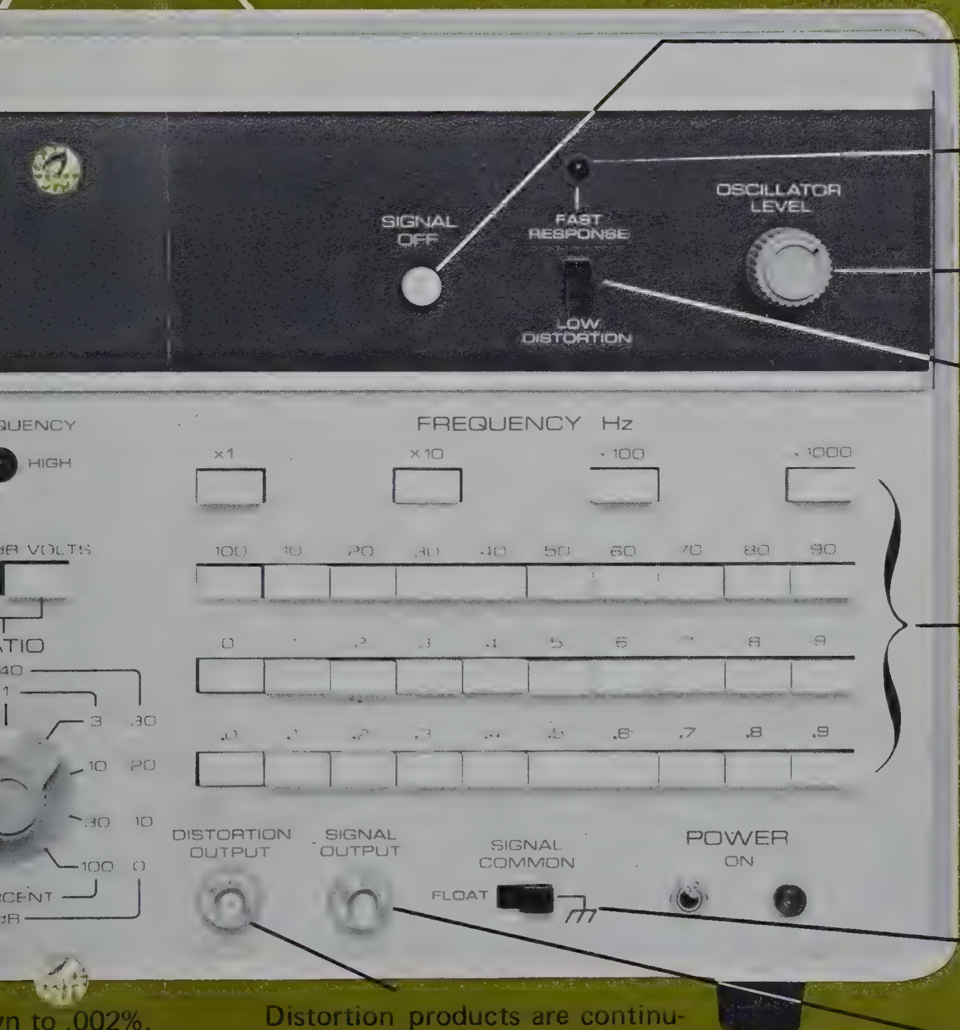
★ *Measure ratios with 100 dB dynamic range.*

★ *Measure power across 8Ω.*

★ *Ultra-low distortion 10 Hz to 110 kHz oscillator.*

Optional Intermodulation Distortion Analyzer





Turn the oscillator off to measure signal-to-noise ratio without re-cabling.

Oscillator distortion is typically .001% in low-distortion mode.

Internal oscillator provides the test signal. Level adjusted with log pot.

Switch lets you choose ultra-low-distortion *(less than 5 sec. settling time)* or fast response operation.

Simultaneously select oscillator and analyzer frequency with fast-to-use pushbuttons. Range is 10Hz to 110 kHz

Switch isolates signal ground from chassis ground, breaks ground loops.

Oscillator output level variable from less than 1mV to 3V.

Distortion products are continuously available for scope viewing — even when the meter is reading input power.

...n to .002%,
...e ratios with
...nge, extend
...capability to

Specifications

TOTAL HARMONIC DISTORTION MEASUREMENT

Fundamental Frequency Range: 10 Hz to 110 kHz in 4 overlapping ranges with 3 digit resolution. Distortion analyzer is tuned simultaneously with oscillator.

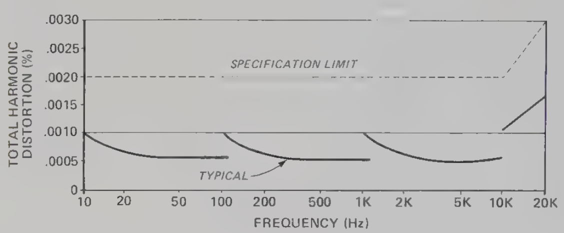
Input Voltage for 100% Set Level: 0.1V to 300V

Distortion Range: .01% to 100% full scale in 9 ranges

Distortion Measurement Accuracy Including Autonull Error for Harmonics to 300 kHz:

Fundamental Frequency	2nd through 5th Harmonic Accuracy
10 Hz – 20 kHz	±1 dB
20.1 kHz – 50 kHz	±2 dB
50.1 kHz – 110 kHz	±3 dB

Residual Distortion:



Above 20 kHz, residual distortion is .007% to 30 kHz, < .02% to 50 kHz, < .05% to 80 kHz, < .1% to 100 kHz.

Noise: If distortion products of the signal under analysis are significant, residual noise will be reduced by the average responding meter. Worst case noise (80 kHz filter in) is .0025% to 10 kHz, .003% to 20 kHz with the measured signal greater than 0.3 vrms. At lower signal levels the noise spec of the voltmeter applies.

Fundamental Rejection: > 100 dB

Input Impedance: 100 kΩ shunted by < 100 pf, balanced to ground

Distortion Output: At least 31.6 mV rms for full scale meter deflection. Output impedance is 1 kΩ.

Voltmeter AC Output: A ranged reproduction of the input signal is available on the rear panel.

Automatic Null: Operates on all distortion ranges. Automatic null time < 6 sec when used with internal oscillator.

Meter Response: Meter indication is proportional to average value of waveform.

Frequency Calibration Accuracy: Better than ±2% of selected frequency.

Common Mode Rejection: > 40 dB at 60 Hz with SET LEVEL ADJUST fully ccw, decreasing to 25 dB with control cw.

Maximum Common Mode Voltage: Not to exceed input voltage range setting or 1V, whichever is greater.

Input Filters:

Low Pass: 3 dB point at 80 kHz with 18 dB/octave rolloff. Normally used only with fundamental frequencies < 20 kHz.

High Pass: 3 dB point at 400 Hz with 18 dB/octave rolloff. 60 Hz rejection > 40 dB. Normally used only with fundamental frequencies > 400 Hz.

VOLTAGE/POWER MEASUREMENT

Frequency Range: 10 Hz – 110 kHz

Input Range: 3 mV to 300V full scale (1 μw to 10 kw across 8Ω) in 11 ranges. Full scale resolution can be extended to 30 μV using RATIO switch.

Input Impedance: 100 kΩ shunted by < 100 pf, balanced to ground.

Voltage Accuracy: ±2% 20 Hz – 20 kHz,
±5% 10 Hz – 110 kHz

Extended Voltage Range Setup: To obtain sensitivities as high as 30 μv full scale, select dB VOLTS, ADJUST control fully ccw, INPUT switch on .3V range.

Residual Noise: < 8 μv with 80 kHz filter in,
< 15 μv with 80 kHz filter out

Power: Power scale converts voltage reading to power across 8Ω.

Common Mode Rejection: > 40 dB

Maximum Common Mode Voltage: Same as above

Voltmeter AC Output: Same as above

RATIO MEASUREMENT

Voltage measurement specifications apply with the following additions:

Input Voltage for 0 dB Set Reference: 0.1V to 300V

Accuracy: ±0.2 dB 20 Hz – 20 kHz,
±0.5 dB 10 Hz – 110 kHz

OSCILLATOR

Frequency Range: 10 Hz to 110 kHz in 4 overlapping ranges with 3 digit resolution. Oscillator is tuned simultaneously with distortion analyzer.

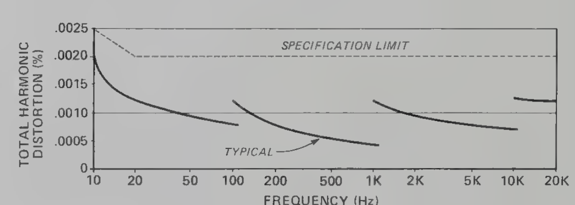
Frequency Accuracy: ±2% of setting

Frequency Response: Flat within 0.2 dB

Output Voltage: Variable 1 mV to 3V with single turn logarithmic pot

Output Impedance: Variable up to 625Ω

Distortion in Low Distortion Mode:



Above 20 kHz, distortion is < .007% to 30 kHz, < .02% to 50 kHz, < .05% to 80 kHz, < .1% to 100 kHz.

Distortion in Fast Response Mode: < .05% 100 Hz – 50 kHz,
< .2% 20 Hz – 110 kHz

Hum and Noise: 100 dB below rated output

GENERAL

Dimensions: 17.2 inches wide, 8.7 inches high, 12 inches deep.

Power: 115V ±10%, 50 to 60 Hz, 18W
220V optional at no charge

Weight: 16 lbs.

Shipping Weight: 21 lbs.

Data subject to change without notice.

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MODEL 1700B

DISTORTION MEASUREMENT SYSTEM

A distortion analyzer and oscillator simultaneously tuned in one fast and easy-to-use system.

- Use the .001% distortion oscillator for testing from 10 Hz to 110 kHz.
- Measure distortion down to .002% in less than 5 seconds.
- Fully automatic nulling eliminates balance controls.
- Measure ac voltage 30 μV full scale to 300V full scale with 2% accuracy.
- Measure voltage or signal-to-noise ratios with 100 dB dynamic range.
- Measure power across 8Ω.
- Differential input measures floating or balanced sources, reduces ground loop and noise pickup.
- Intermodulation Distortion Measurement capability and Automatic Set Level optionally available.

SOUND TECHNOLOGY

1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

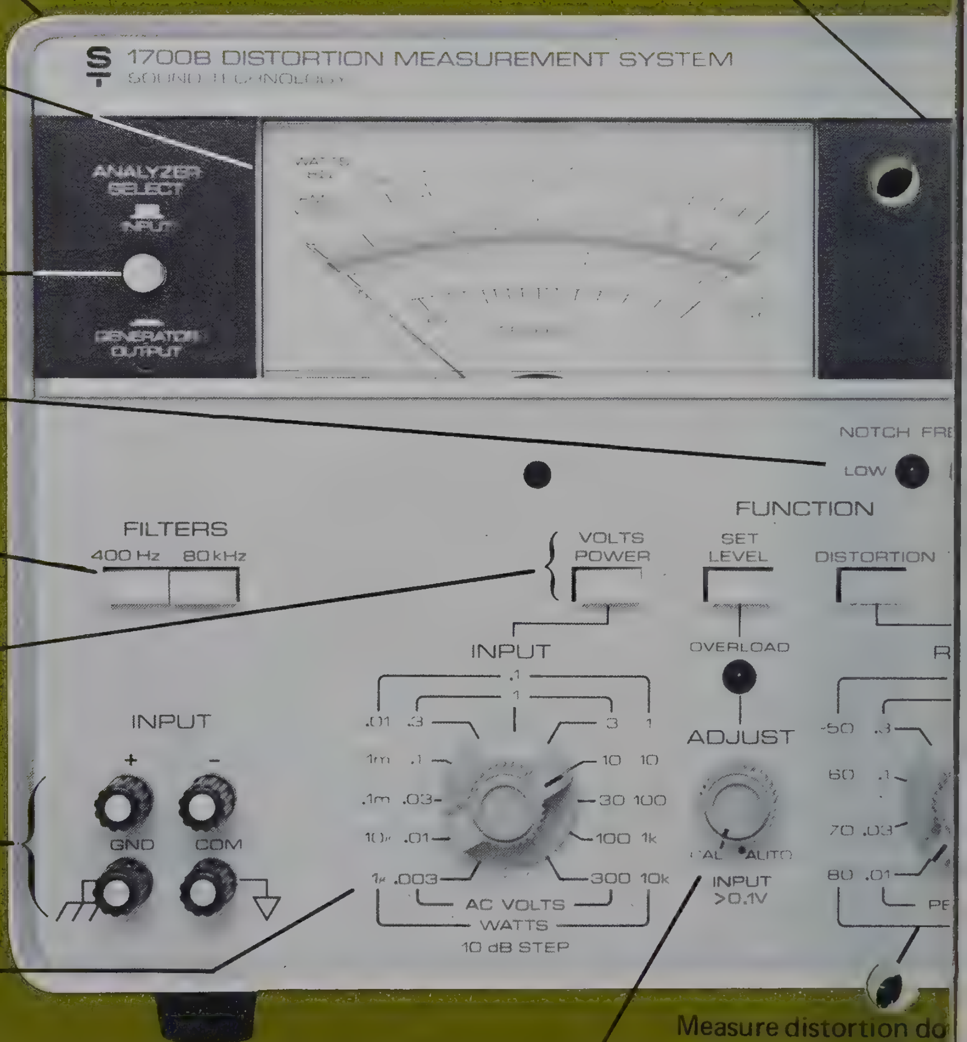
MODEL 1700B

Distortion Measurement System

Replica of input signal, referenced to ground, always available at rear panel.

No manual nulling controls are required — the 1700B is always in auto-null, reaches a null in less than 5 seconds.

0.5% taut band meter monitors voltage, power, distortion or dB ratio.



Monitor the internal oscillator merely by pushing a button.

Tuning indicators help you when measuring distortion of an external source.

Selectable 18 dB per octave filters reject hum and high frequency noise.

Fast pushbutton operation lets you set level, measure voltage or power, then measure distortion — no range changing required.

Differential Input lets you measure strapped amplifiers or amplifiers with floating outputs, breaks ground loops.

Measure voltage or power from 10 Hz to 110 kHz. Accuracy on voltage is 2%.

Measure distortion do voltage or signal to no 100 dB dynamic r voltage measurement 30μV full scale.

Set 100% reference level on signals from 300V down to 0.1V. Automatic Set Level is optionally available. (See 1700B Option 003 data sheet.)

MODELS 1700B/1710B
Option 003

DISTORTION MEASUREMENT SYSTEM

WITH AUTOMATIC SET LEVEL

NEVER TOUCH
THIS KNOB AGAIN

Your system will be even faster and easier to use with automatic set level.

AUTOMATIC SET LEVEL SIMPLIFIES:

- Distortion vs. Power or Voltage Measurements
- Distortion vs. Frequency Measurements
- IHF Sensitivity Measurements in Tuners
- Distortion at Clipping Measurement in Amplifiers
- Finding the 3% Distortion Level in Tape Recorders

SOUND TECHNOLOGY

1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

Specifications

Model 1700B specifications apply with the following additions:

Capture Range: 10 dB. INPUT switch must be set for meter reading in upper 2/3 scale in VOLTS/POWER function.

Harmonic Accuracy: Add to 1700B specification

Fundamental Frequency	2nd through 5th Harmonic Accuracy
10 Hz - 20 kHz	± .2 dB
20.1 kHz - 50 kHz	± .5 dB
50.1 kHz - 110 kHz	± 1 dB

Noise: (worst case with 80 kHz filter in) .007% to 20 kHz with the measured signal greater than 0.3 vrms. Noise decreases to the standard 1700B specification as input voltage approaches full scale. Automatic Set Level can be disabled to reduce noise for high resolution readings.

All prices f.o.b. Campbell, California — data subject to change without notice.

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MODEL 1700B

DISTORTION MEASUREMENT SYSTEM

A distortion analyzer and oscillator simultaneously tuned in one fast and easy-to-use system.

- Use the .001% distortion oscillator for testing from 10 Hz to 110 kHz.
- Measure distortion down to .002% in less than 5 seconds.
- Fully automatic nulling eliminates balance controls.
- Measure ac voltage 30 μV full scale to 300V full scale with 2% accuracy.
- Measure voltage or signal-to-noise ratios with 100 dB dynamic range.
- Measure power across 8Ω.
- Differential input measures floating or balanced sources, reduces ground loop and noise pickup.
- Intermodulation Distortion Measurement capability and Automatic Set Level optionally available.

SOUND TECHNOLOGY

1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

MODEL 1700B

Distortion Measurement System

Replica of input signal, referenced to ground, always available at rear panel.

No manual nulling controls are required — the 1700B is always in auto-null, reaches a null in less than 5 seconds.

0.5% taut band meter monitors voltage, power, distortion or dB ratio.

Monitor the internal oscillator merely by pushing a button.

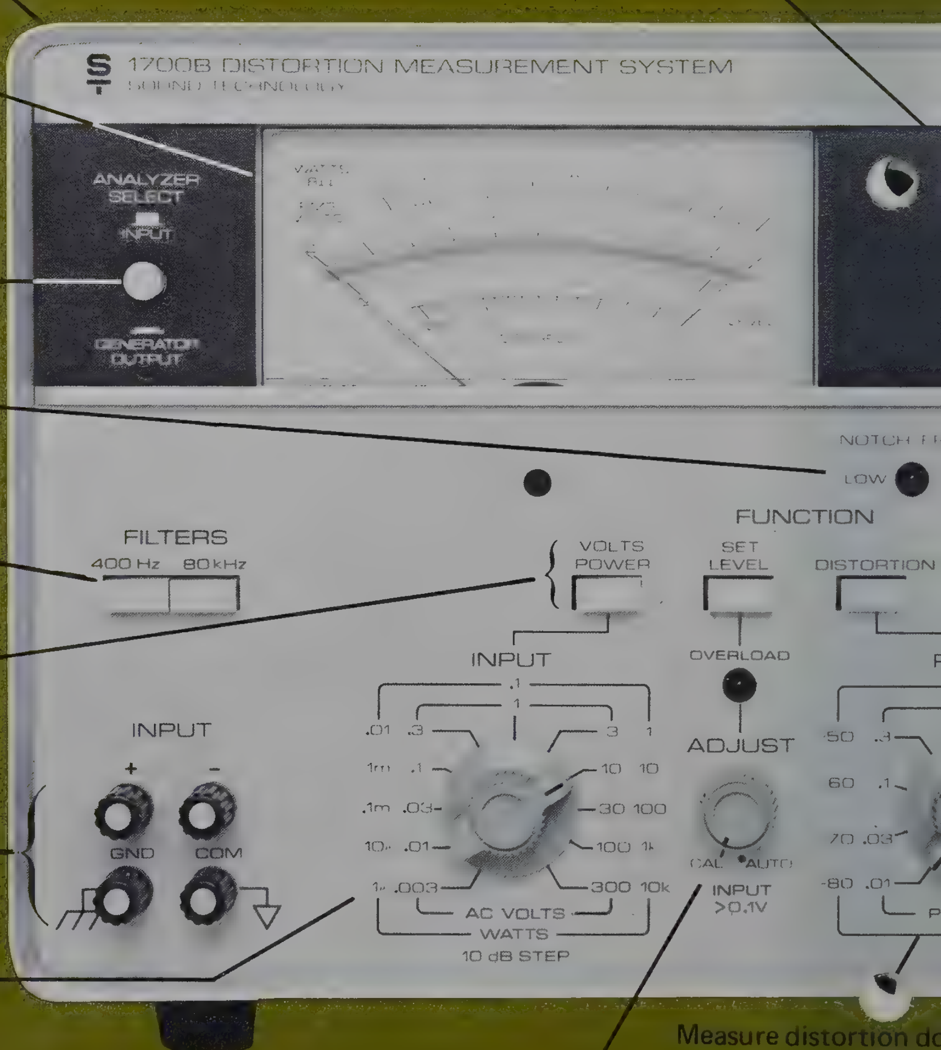
Tuning indicators help you when measuring distortion of an external source.

Selectable 18 dB per octave filters reject hum and high frequency noise.

Fast pushbutton operation lets you set level, measure voltage or power, then measure distortion — no range changing required.

Differential Input lets you measure strapped amplifiers or amplifiers with floating outputs, breaks ground loops.

Measure voltage or power from 10 Hz to 110 kHz. Accuracy on voltage is 2%.

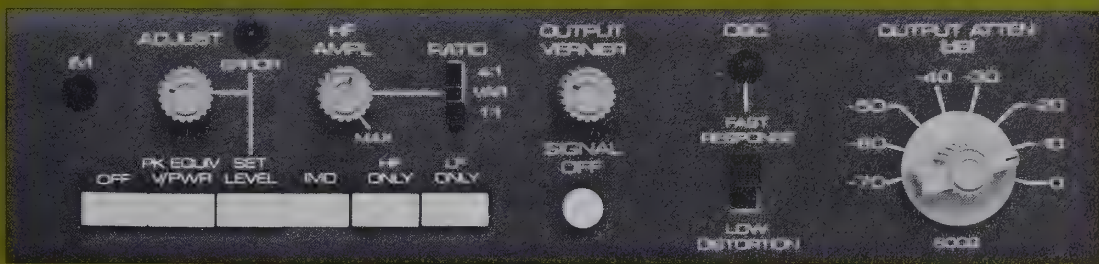


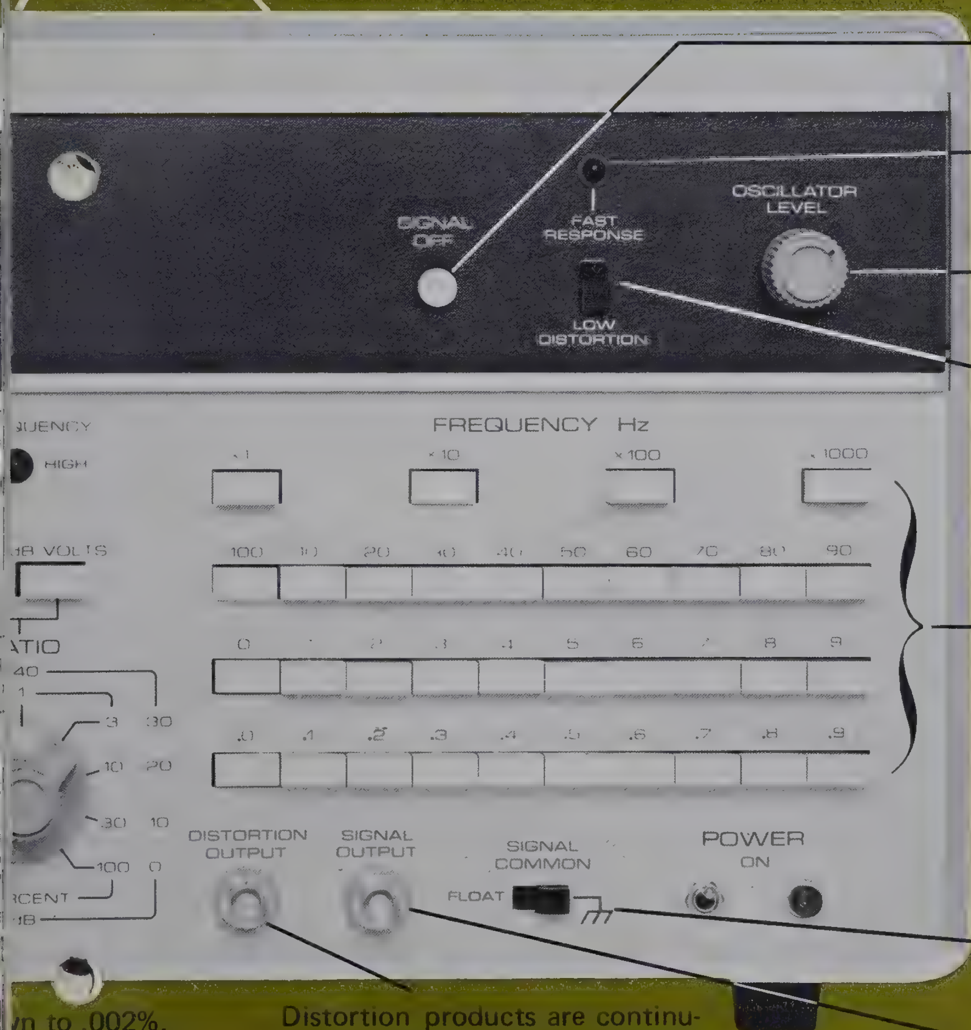
Set 100% reference level on signals from 300V down to 0.1V. Automatic Set Level is optionally available. (See 1700B Option 003 data sheet.)

Measure distortion do
voltage or signal to no
100 dB dynamic r
voltage measurement
30μV full scale.

- ★ *Measure .002% distortion in less than 5 seconds.*
- ★ *Measure ac voltage with 2% accuracy.*
- ★ *Measure ratios with 100 dB dynamic range.*
- ★ *Measure power across 8Ω.*
- ★ *Ultra-low distortion 10 Hz to 110 kHz oscillator.*

Optional Intermodulation Distortion Analyzer





Turn the oscillator off to measure signal-to-noise ratio without re-cabling.

Oscillator distortion is typically .001% in low-distortion mode.

Internal oscillator provides the test signal. Level adjusted with log pot.

Switch lets you choose ultra-low-distortion *(less than 5 sec. settling time)* or fast response operation.

Simultaneously select oscillator and analyzer frequency with fast-to-use pushbuttons. Range is 10Hz to 110 kHz

...n to .002%, ...e ratios with ...nge, extend ...capability to

Distortion products are continuously available for scope viewing — even when the meter is reading input power.

Switch isolates signal ground from chassis ground, breaks ground loops.

Oscillator output level variable from less than 1mV to 3V.

Specifications

TOTAL HARMONIC DISTORTION MEASUREMENT

Fundamental Frequency Range: 10 Hz to 110 kHz in 4 overlapping ranges with 3 digit resolution. Distortion analyzer is tuned simultaneously with oscillator.

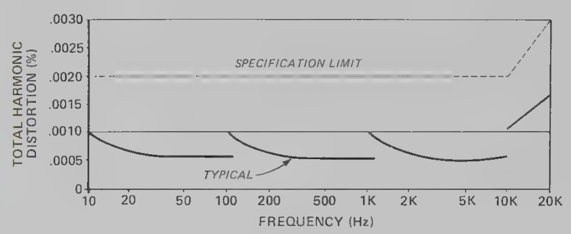
Input Voltage for 100% Set Level: 0.1V to 300V

Distortion Range: .01% to 100% full scale in 9 ranges

Distortion Measurement Accuracy Including Autonull Error for Harmonics to 300 kHz:

Fundamental Frequency	2nd through 5th Harmonic Accuracy
10 Hz – 20 kHz	±1 dB
20.1 kHz – 50 kHz	±2 dB
50.1 kHz – 110 kHz	±3 dB

Residual Distortion:



Above 20 kHz, residual distortion is .007% to 30 kHz, <.02% to 50 kHz, <.05% to 80 kHz, <.1% to 100 kHz.

Noise: If distortion products of the signal under analysis are significant, residual noise will be reduced by the average responding meter. Worst case noise (80 kHz filter in) is .0025% to 10 kHz, .003% to 20 kHz with the measured signal greater than 0.3 vrms. At lower signal levels the noise spec of the voltmeter applies.

Fundamental Rejection: > 100 dB

Input Impedance: 100 kΩ shunted by < 100 pf, balanced to ground

Distortion Output: At least 31.6 mV rms for full scale meter deflection. Output impedance is 1 kΩ.

Voltmeter AC Output: A ranged reproduction of the input signal is available on the rear panel.

Automatic Null: Operates on all distortion ranges. Automatic null time < 6 sec when used with internal oscillator.

Meter Response: Meter indication is proportional to average value of waveform.

Frequency Calibration Accuracy: Better than ±2% of selected frequency.

Common Mode Rejection: > 40 dB at 60 Hz with SET LEVEL ADJUST fully ccw, decreasing to 25 dB with control cw.

Maximum Common Mode Voltage: Not to exceed input voltage range setting or 1V, whichever is greater.

Input Filters:

Low Pass: 3 dB point at 80 kHz with 18 dB/octave rolloff. Normally used only with fundamental frequencies < 20 kHz.

High Pass: 3 dB point at 400 Hz with 18 dB/octave rolloff. 60 Hz rejection > 40 dB. Normally used only with fundamental frequencies > 400 Hz.

VOLTAGE/POWER MEASUREMENT

Frequency Range: 10 Hz – 110 kHz

Input Range: 3 mV to 300V full scale (1 μw to 10 kw across 8Ω) in 11 ranges. Full scale resolution can be extended to 30 μV using RATIO switch.

Input Impedance: 100 kΩ shunted by < 100 pf, balanced to ground.

Voltage Accuracy: ±2% 20 Hz – 20 kHz,
±5% 10 Hz – 110 kHz

Extended Voltage Range Setup: To obtain sensitivities as high as 30 μv full scale, select dB VOLTS, ADJUST control fully ccw, INPUT switch on .3V range.

Residual Noise: < 8 μv with 80 kHz filter in,
< 15 μv with 80 kHz filter out

Power: Power scale converts voltage reading to power across 8Ω.

Common Mode Rejection: > 40 dB

Maximum Common Mode Voltage: Same as above

Voltmeter AC Output: Same as above

RATIO MEASUREMENT

Voltage measurement specifications apply with the following additions:

Input Voltage for 0 dB Set Reference: 0.1V to 300V

Accuracy: ±0.2 dB 20 Hz – 20 kHz,
±0.5 dB 10 Hz – 110 kHz

OSCILLATOR

Frequency Range: 10 Hz to 110 kHz in 4 overlapping ranges with 3 digit resolution. Oscillator is tuned simultaneously with distortion analyzer.

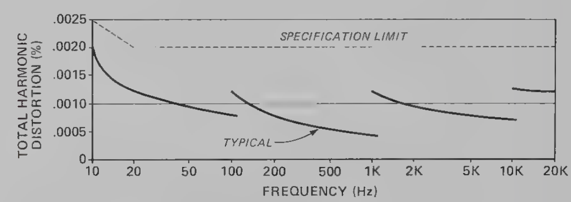
Frequency Accuracy: ±2% of setting

Frequency Response: Flat within 0.2 dB

Output Voltage: Variable 1 mV to 3V with single turn logarithmic pot

Output Impedance: Variable up to 625Ω

Distortion in Low Distortion Mode:



Above 20 kHz, distortion is < .007% to 30 kHz, < .02% to 50 kHz, < .05% to 80 kHz, < .1% to 100 kHz.

Distortion in Fast Response Mode: < .05% 100 Hz – 50 kHz,
< .2% 20 Hz – 110 kHz

Hum and Noise: 100 dB below rated output

GENERAL

Dimensions: 17.2 inches wide, 8.7 inches high, 12 inches deep.

Power: 115V ±10%, 50 to 60 Hz, 18W
220V optional at no charge

Weight: 16 lbs.

Shipping Weight: 21 lbs.

Data subject to change without notice.

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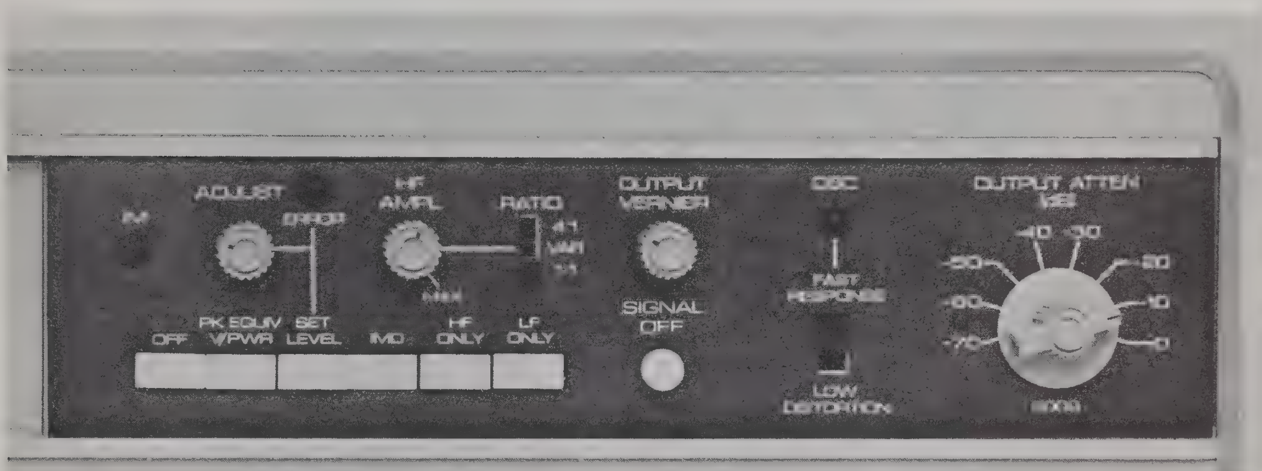
MODEL 1700B
Option 004

INTERMODULATION DISTORTION ANALYZER



Measure total harmonic distortion and intermodulation distortion with one instrument—

THIS OPTION FITS RIGHT IN THE 1700B DISTORTION MEASUREMENT SYSTEM

- Measures Intermodulation Distortion down to .0025%.
- 70 dB Output Attenuator tracks 1700B Input Switch for rapid measurements, works when measuring THD, too.
- Available with automatic set level to cover between 10 dB steps for even faster operation.
- 4:1 and 1:1 ratios are switch selectable. No HF or LF adjustment required.
- Continuously adjustable LF:HF ratio lets you choose the ratio you want using the 1700B meter.
- Measures peak equivalent single-tone voltage or power.

SOUND TECHNOLOGY

1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

Specifications

MEASUREMENT SECTION

All 1700B specifications and performance features are retained with the following additions.

Intermodulation Distortion Ranges: 0.01% to 100% full scale in 9 ranges.
Residual Intermodulation Distortion and Noise: < 0.0025% with internal generators set at 4:1 for input signals greater than 0.3V (10 mw across 8Ω). < 0.004% for input signals 0.1V to 0.3V.
Intermodulation Distortion Accuracy: ±2% full scale.
Peak Equivalent Single Tone RMS Voltage Accuracy: ±2% full scale.

GENERATOR SECTION

Output attenuator and vernier control the single tone sinewave oscillator output as well as the intermodulation distortion generator output. All 1700B oscillator specifications apply except output level control is via the attenuator and output impedance is 600Ω.

Output Voltage: 1mV to 3V open circuit, peak equivalent single tone RMS.
Output Attenuator: 70 dB in 10 dB steps, accurate within ±0.1 dB.
Output Vernier: > 10 dB range, continuously adjustable.
Output Impedance: 600Ω ±1%.
Low Frequency Generator: 50 or 60 Hz synchronized with power line. Total Harmonic Distortion < 0.1%.
High Frequency Generator: 7 kHz ±1%.
LF/HF Ratio: Switch selectable 4:1 ±1% or 1:1 ±2%. Continuously variable from 1:1 to > 100:1 with HF amplitude control.

GENERAL

Weight: Adds 5 lbs. to 1700B weight.

Data subject to change without notice.

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MODELS 1700B/1710B
Option 003

DISTORTION MEASUREMENT SYSTEM

WITH AUTOMATIC SET LEVEL

NEVER TOUCH
THIS KNOB AGAIN

Your system will be even faster and easier to use with automatic set level.

AUTOMATIC SET LEVEL SIMPLIFIES:

- Distortion vs. Power or Voltage Measurements
- Distortion vs. Frequency Measurements
- IHF Sensitivity Measurements in Tuners
- Distortion at Clipping Measurement in Amplifiers
- Finding the 3% Distortion Level in Tape Recorders

SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

Specifications

Model 1700B specifications apply with the following additions:

Capture Range: 10 dB. INPUT switch must be set for meter reading in upper 2/3 scale in VOLTS/POWER function.

Harmonic Accuracy: Add to 1700B specification

Fundamental Frequency	2nd through 5th Harmonic Accuracy
10 Hz – 20 kHz	± .2 dB
20.1 kHz – 50 kHz	± .5 dB
50.1 kHz – 110 kHz	± 1 dB

Noise: (worst case with 80 kHz filter in) .007% to 20 kHz with the measured signal greater than 0.3 vrms. Noise decreases to the standard 1700B specification as input voltage approaches full scale. Automatic Set Level can be disabled to reduce noise for high resolution readings.

All prices f.o.b. Campbell, California — data subject to change without notice.

Printed in U.S.A. 1/76

PRICE $10.00

MODEL 1700B
DISTORTION MEASUREMENT
SYSTEM

SOUND TECHNOLOGY

SERIAL NO.________________

1400 Dell Avenue
CAMPBELL, CALIFORNIA 95008
U.S.A.
(408-378-6540)
*Patents Pending
January 1976